

Federal Enterprise Architecture Framework

Version 1.1

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Developed by: The Chief Information Officers Council

The undersigned chairs do hereby endorse this Federal Enterprise Architecture Framework and consider it to be a road map for the Federal Government in achieving better alignment of technology solutions with business mission needs.

Signed: August 5, 1999

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Preface

Executive Order 13011, *Federal Information Technology*, established the Chief Information Officers (CIO) Council as the principal interAgency forum for improving practices in the design, modernization, use, sharing, and performance of Federal information resources. The Clinger-Cohen Act of 1996 assigned the CIOs with the responsibility to develop information technology architectures (ITAs). The Office of Management and Budget (OMB) M-97-02, *Funding Information Systems Investments*, October 1996, requires that Agency investments in major information systems be consistent with Federal, Agency, and Bureau ITAs. The CIO Council began developing the Federal Enterprise Architecture Framework in April 1998 to promote shared development for common Federal processes, interoperability, and sharing of information among the Agencies of the Federal Government and other Governmental entities.

In serving the strategic needs and direction of the Federal Government, the CIO Council seeks to develop, maintain, and facilitate the implementation of the top-level enterprise architecture for the Federal Enterprise. The Framework consists of various approaches, models, and definitions for communicating the overall organization and relationships of architecture components required for developing and maintaining a Federal Enterprise Architecture. The CIO Council chose a segment architecture approach that allows critical parts of the overall Federal Enterprise, called architectural segments, to be developed individually, while integrating these segments into the larger Enterprise Architecture. Federal Agencies can use the same or a modified approach to develop their ITAs in response to the Clinger-Cohen Act. In either case, the Framework can help with architecture development efforts at Federal organizations.

The architecture will serve as a reference point to facilitate the efficient and effective coordination of common business processes, information flows, systems, and investments among Federal Agencies and other Governmental entities. In time, Government business processes and systems will operate seamlessly in an enterprise architecture that provides models and standards that identify and define the information services used throughout the Government.

Credits

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The Subgroup acknowledges the work of the various groups that provided valuable recommendations and information and contributed to this document.

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Special recognition is extended to Francine Yoder and George Brundage for their work as Chairpersons of the Federal Architecture Framework Subgroup and to Michael Tiemann for his work as the Chairperson of the Federal Agency Information Architecture Working Group.

Contents

Introduction	1
Background	1
Purpose	3
Approach	4
Framework Components	5
Federal Enterprise Architecture Vision and Principles	9
Vision	9
Principles	9
Federal Enterprise Architecture Framework	13
Overview	13
Level I	14
Level II	15
Level III	17
Level IV	19
Framework Summary	32
Returns, Risks, and Costs of the Federal Enterprise Architecture	33
Returns	33
Better Information	33
Facilitated Decision Making	34
Potentials for Cost Reduction	34
Risks	35
Costs	36
Start-up Architecture Development Costs	36
Recurring IT Operations Costs	36
Opportunity Costs	38
Conclusion	39
Appendixes	
Appendix A - Petition to Be Designated A Federal Information Architecture Segment	A-1
Appendix B - Remaining Models	B-1
Appendix C - Glossary of Terms	C-1
Appendix D - References	D-1

Introduction

Background

Executive Order 13011, *Federal Information Technology*, established the Chief Information Officers (CIO) Council as the principal interAgency forum for improving practices in the design, modernization, use, sharing, and performance of Agency information resources.

The CIO Council began developing the Federal Enterprise Architecture Framework in April 1998. The *CIO Council Strategic Plan*, dated January 1998, guided by priorities of the Clinger-Cohen Act of 1996, directed the development and maintenance of a Federal Enterprise Architecture to maximize the benefits of information technology (IT) within the Government. According to this Strategic Plan, architectures for selected high priority, cross-Agency business lines or segments will be developed to populate the Federal Enterprise Architecture. The Framework provides a sustainable mechanism for identifying, developing, and documenting architecture descriptions of high priority areas built on common business areas and designs that cross organizational boundaries.

The Federal Enterprise Architecture Framework provides an organized structure and a collection of common terms by which Federal segments can integrate their respective architectures into the Federal Enterprise Architecture.

The CIO Council developed the Framework, which is nonrestrictive and easily adaptable to all Federal Agencies especially those with existing architectures. The CIO Council and its related working groups consist of representatives from many Agencies, whose contributions include protecting the interests of architecture efforts within their organizations and recognizing the need for a Governmentwide approach.



What elements comprise the Federal Enterprise?

The Federal Enterprise includes organizations of the Federal Government and all partners. Federal organizations refers to Tier 1-Large Major Federal Departmental Systems, Tier 2-Departmental Subagency and Bureau Systems, and Tier 3-All Other Federal Agency Systems.

The focus of the Federal Enterprise Architecture is limited to the common Federal architecture issues, which benefit Federal organizations and the public.

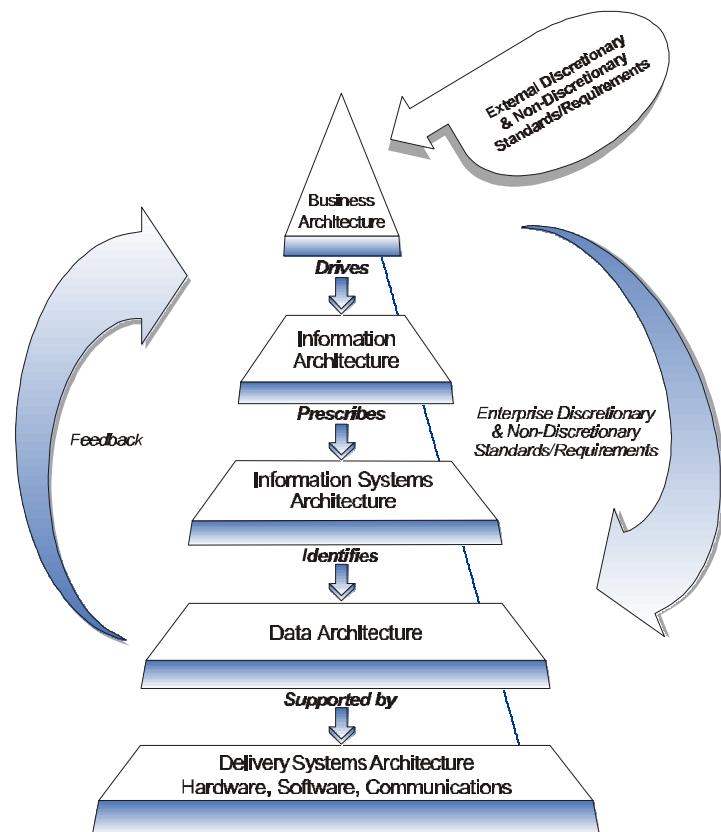
At the onset, the CIO Council agreed to use the widely accepted National Institute of Standards and Technology (NIST) model¹ (exhibit 1) and expand on this foundation to meet the organizational and management needs of a Federal Enterprise Architecture. The NIST model has been promoted within the Federal Government as a management tool that illustrates the interrelationship of enterprise business, information, and technology environments. The five-layered model allows for organizing, planning, and building an integrated set of information and information technology architectures. The five layers are defined separately but are interrelated and interwoven.

The CIO Council has adopted architecture layers similar to the NIST model for the Federal Enterprise Architecture Framework with a slightly different concept of the Federal Enterprise that reflects recent IT advancements.

The Federal Enterprise Architecture is a strategic information asset base that defines the business, information necessary to operate the business, technologies necessary to support the business operations, and transitional processes for implementing new technologies in response to the changing needs of the business.

The Federal Enterprise Architecture Framework is a conceptual model that begins to define a documented and coordinated structure for cross-cutting businesses and design developments in the Government. Collaboration among the Agencies with a vested interest in a Federal segment will result in increased efficiency and economies of scale. Agencies should use the Framework to describe segments of their architectures.

Exhibit 1, NIST Enterprise Architecture Model



¹ NIST Special Publication 500-167, *Information Management Directions: The Integration Challenge*. September 1989.

Purpose

The Federal Enterprise Architecture Framework promotes shared development for common Federal processes, interoperability, and sharing of information among Federal Agencies and other Governmental entities.

Why develop a Federal Enterprise Architecture Framework?

A Federalwide collaboration tool is needed to collect common architecture information and build a repository for storing this information. A Federal Enterprise Architecture Framework is such a tool and repository. The Framework allows the Federal Government to accomplish the following.

- ☐ Organize Federal information on a Federalwide scale
- ☐ Promote information sharing among Federal organizations
- ☐ Help Federal organizations develop their architectures
- ☐ Help Federal organizations quickly develop their IT investment processes
- ☐ Serve customer needs better, faster, and cost effectively

As mandated in the Clinger-Cohen Act of 1996, Federal Agencies must develop and maintain an enterprise IT architecture. Increasingly, Federal Agencies are finding that architecture development is tied to capital IT investment planning processes. This development process is, even at an Agency level, a large, complex, resource-intensive effort. By collaborating on cross-cutting activities, Federal Agencies can share staff efforts and products, thereby leveraging budget resources and lessening burdens. Collaboration can also encourage development of interoperability standards, which in turn, promote Federalwide information sharing and common capabilities. A better understanding of common Federal processes, information, and other areas where economies of scale might be applied can also evolve through collaboration.

The Federal Enterprise Architecture Framework is recommended for use in the following efforts.

- ☐ Federal Governmentwide efforts
- ☐ Multi-Federal Agency (i.e., two or more Agencies) efforts
- ☐ Whenever Federal business areas and substantial Federal investments are involved with international, State, or local governments

The goal of the CIO Council is to develop a framework to prepare an enterprise architecture description (i.e., the architecture). The Framework consists of various approaches, models, and definitions for communicating the overall organization and relationships of architecture components required for developing and maintaining a Federal Enterprise Architecture. The Framework must be flexible to allow for new activities and focus on common Federal Enterprise Architecture activities, address the realities of the Federal workplace, and provide immediate successes.

This document does not define the Federal Enterprise Architecture content; rather, it defines an organizational framework and architecture activities place-holder for future population of Federal Enterprise Architecture information.

The value of the Federal Enterprise Architecture Framework is that it provides a mechanism for linking Agency Federal Architecture activities, and promotes the development of quick successes within an overall Federal Architecture plan. This link allows Agencies to work their architecture issues within the broader context of the Federal Enterprise Architecture to reap the benefits of resource sharing and interoperability. Additionally, by allowing for quick successes, the model addresses real-world business needs of initiatives that provide strategic value.

What is the value of a Federal Enterprise Architecture Framework?

- ☐ Promote Federal *interoperability*
- ☐ Promote Agency *resource sharing*
- ☐ Provide potential for Federal and Agency *reduced costs*
- ☐ Improve ability to *share information*
- ☐ Support Federal and Agency *capital IT investment planning*

Approach

In developing the Federal Enterprise Architecture Framework, the CIO Council evaluated three approaches.

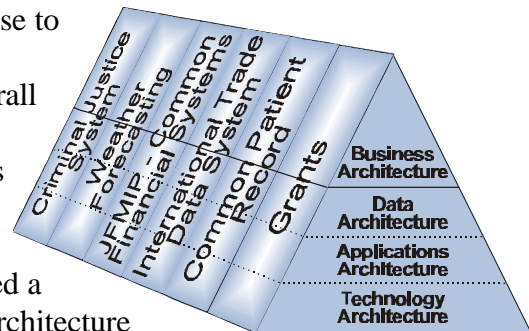
- ☐ **Conventional Approach** - Requires a substantial initial investment in time and dollars. First, a framework must be developed that shows how to prepare an architecture description. Second, the current baseline must be described. Finally, a target architecture must be described. Only after these activities are completed, implementing needed architecture changes through design, development, and acquisition of systems can begin. Although this approach appears to be sound, it may result in "paralysis by analysis," because of the complexity of the Federal effort.
- ☐ **Segment Approach** - Promotes the incremental development of architecture segments within a structured enterprise architecture framework. This approach focuses on major business areas (e.g., grants or common financial systems) and is more likely to succeed because the effort is limited to common functions or specific enterprises.

- ❑ **Status Quo Approach** - Represents business as usual resulting in continued failure to share information and cope with the rapidly changing environment. This approach would result in business rework, decreased productivity, and lost and missed opportunities, as well as failure to comply with Clinger-Cohen Act requirements.

Today, many initiatives and interAgency efforts are underway for implementing Agency architectures. Agency initiatives are necessary to support Federal business needs and should not be delayed pending the development of current and target Federal Architectures. The Federal Enterprise Architecture effort should not impede individual Agency architecture efforts.

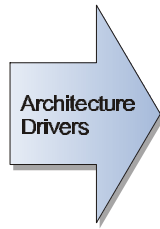
To mitigate the risk of overreaching with minimal returns, curtail startup costs for a conventional architecture, and realize returns quickly, the CIO Council selected the segment approach.

A conventional architecture methodology would probably cease in-progress architecture initiatives to develop Federalwide current and target architectures. Obviously, this paradigm is unrealistic and does not meet Government business needs. The solution is a framework that supports immediate response to urgent Agency business needs. The Federal Enterprise Architecture Framework allows critical parts of the overall Federal Enterprise, called architectural segments, to be developed individually, while integrating these segments into the larger Enterprise Architecture. In May 1999, the CIO Council drafted a process for identifying and approving Federal segments. The CIO Council proposed a form or petition for designating a Federal information architecture segment. The form is provided as appendix A, Petition to be Designated a Federal Information Architecture Segment. For more information on identifying and approving Federal segments, visit the *ArchitecturePlus* web site (refer to appendix D, References).



Framework Components

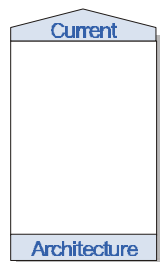
In designing the Framework, the CIO Council identified eight components necessary for developing and maintaining the Federal Enterprise Architecture, then drilled down to a further granularity of detail. The flow and detail of the Framework are discussed in the Federal Enterprise Architecture Framework section of this document. The following is a brief overview of the eight Framework components.



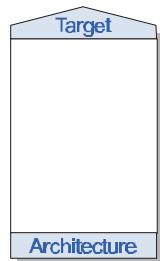
Architecture Drivers - Represent two types of external stimuli or change agents for the enterprise architecture: business and design. The business drivers could be new legislation, new administration initiatives, budget enhancements for accelerated focus areas, and market forces. Design drivers include new and enhanced software and hardware and their combinations with a variety of deployment approaches.



Strategic Direction - Guides the development of the target architecture and consists of a vision, principles, and goals and objectives.



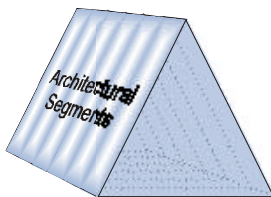
Current Architecture - Defines the "as is" enterprise architecture and consists of two parts: current business and design architectures (i.e., data, applications, and technology). This is a representation of current capabilities and technologies and is expanded as additional segments are defined.



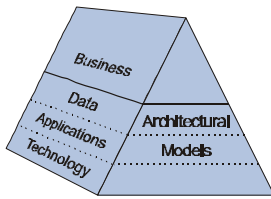
Target Architecture - Defines the "to-be-built" enterprise architecture and consists of two parts: target business and design architectures (i.e., data, applications, and technology). This represents the future capabilities and technologies resulting from design enhancements to support changing business needs.



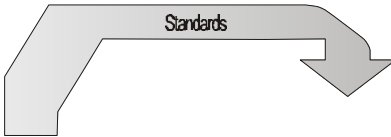
Transitional Processes - Support the migration from the current to the target architecture. Critical transition processes for the Federal Enterprise include capital IT investment planning, migration planning, configuration management, and engineering change control.



Architectural Segments - Consist of focused architecture efforts on major cross-cutting business areas, such as common administrative systems; program areas, such as trade and grants; or small purchases via electronic commerce. They represent a portion (segment) of the overall enterprise architecture. A segment is considered to be an enterprise within the total Federal Enterprise.



Architectural Models - Define the business and design models that comprise the segments of the enterprise description.



Standards - Refer to all standards (some of which may be mandatory), guidelines, and best practices.

Federal Enterprise Architecture Vision and Principles

The Federal Enterprise Architecture vision and principles are based upon recent laws that address the importance of getting results, obtaining maximum return-on-investment and cost efficiency of operations, providing quality information and technology, protecting privacy, maintaining secure information, and providing service to the public.

Vision

The Federal Enterprise Architecture vision, adopted by the CIO Council, identifies *what* must be done to serve the strategic needs and direction of the Federal Government.

The Federal CIO Council seeks to develop, maintain, and facilitate the implementation of the top-level enterprise architecture for the Federal Enterprise. This architecture will serve as a reference point to facilitate the efficient and effective coordination of common business processes, information flows, systems, and investments among Federal Agencies. In time, Government business processes and systems will operate seamlessly in an enterprise architecture that provides models and standards that identify and define the information services used throughout the Government.

Principles

The Federal Enterprise Architecture principles adopted by the CIO Council govern and represent the criteria against which all potential investment and architectural decisions are weighed.

1. Standards: Establish Federal interoperability standards.

Rationale: The Federal Government has not achieved data, applications, and technology interoperability. Connectivity is often the last requirement addressed. It is difficult to control lifecycle costs and schedules and improve performance, take advantage of commercial items and technology, and maintain and evolve systems. In addition, the Federal Government requires connectivity between multiple processing environments and applications operating on a variety of technology platforms

Implications: The Federal Government should adopt open system standards in which the interrelationships of components are fully defined by interface standards available to the public and maintained by group consensus. The Federal Government should adopt, acquire, and integrate those components that conform to specification. An open system architecture is the goal; however, initially only partially open systems will be attained. This principle could lead to use of JAVA and future JAVA-like protocols, which give a high priority to platform

independence. The Federal Government should be able to ensure compliance with these standards.

2. Investments: Coordinate technology investments with the Federal business and architecture.

Rationale: The completed current architecture, or a portion of it, should be considered the baseline or the starting point for optimization. Optimization will occur over time and investments made consistent with the business needs (i.e., over individual needs) and incorporated into the architecture. It is important to define the current and target positions and identify those investments in the architecture that will achieve the target position.

Implications: Compliance mechanisms are necessary to ensure that investments are funded by business and architectural decisions and consistently align the architecture with business needs. This alignment applies to multiagency and Governmentwide investments, as well as Agency and Bureau investments to achieve vertical integration. Technology advances are welcome, and the technology blueprint can change when compatibility with the current infrastructure, improvement in operational efficiency, or a required capability is demonstrated.

3. Data Collection: Minimize the data collection burden.

Rationale: The Federal Government should be able to collect, manipulate, and transmit accurate and consistent data quickly and easily. The lack of data integration due to incompatible database structures; poor quality and integrity of data; and the mixture of organizations, processes, and business rules with data, hinder data collection, manipulation, and transmission. Data should be shared across the Federal Government.

Implications: Data standardization, including a common vocabulary and data definition, will be difficult to achieve but is critical. A common organization eliminates redundancy and ensures data consistency. To ensure success, business units as well as IT personnel should be involved. Each data element should have a trustee accountable for data quality.

4. Security: Secure Federal information against unauthorized access.

Rationale: The Federal Government must be aware of security breaches and data compromise and the impact of these events. Appropriate security monitoring and planning, including an analysis of risks and contingencies and the implementation of appropriate contingency plans must be completed to prevent unauthorized access to Federal information. Information security must be ensured and increased, commensurate with increased access to Federal information.

Implications: Protecting systems from spies, terrorists, and hackers requires considerable effort and costs. The business unit manager, where each system is implemented, must take responsibility for security measures and contingency plans as required by Presidential Decision Directive-63 (PDD-63), *Critical Infrastructure Protection*.

5. *Functionality: Take advantage of standardization based on common functions and customers.*

Rationale: Due to a lack of standardization on common functions and customers, Federal Agencies have not taken advantage of reuse or incorporated commercial products into Federal systems. Applications have not been developed using standard system components shared across the organization. Additionally, similar or duplicative applications have been developed.

Implications: Federal Agencies should develop or design reusable components or purchase architecture components, recognizing that these items are designed to obtain a particular functionality. Increasingly, the Federal Government is becoming a consumer as opposed to the producer of components; this role requires new skills and abilities. Standardization on common functions and customers will help Federal Agencies implement change in a timely manner. For commercial and Government-off-the-Shelf (GOTS) software applications, current choices may be limited, as many of these applications are technology and platform dependent.

6. *Information Access: Provide access to information.*

Rationale: In accordance with the Paperwork Reduction Act (PRA, PL 104-13), the Federal employee and the public should have access to Government information efficiently, effectively, and economically. The right information should be attainable any place, any time, and in the right format.

Implications: The Federal Government should encourage a diversity of public and private access methods for Government public information, including multiple access points, the separation of transactional from analytical data, and data warehousing architecture. Accessibility involves the ease with which users obtain information. Information access and display must be sufficiently adaptable to a wide range of users and access methods, including formats accessible to those with sensory disabilities.

7. *Proven Technologies: Select and implement proven market technologies.*

Rationale: Federal Agencies often concentrate attention on "bleeding edge" technology, which results in wasted time and effort. The Federal Enterprise Architecture should focus on proven market technologies implemented within a reasonable period. Business flexibility has been lost and the Government has not adjusted quickly to change. Unfortunately, the environment is often a tangled web of systems, making implementation of proven market technology difficult.

Implications: Systems should be developed based on global data classes and process boundaries. Systems should be decoupled to allow maximum flexibility. Incorporating new or proven technology in a timely manner will help Agencies to cope with change.

8. *Privacy: Comply with the Privacy Act of 1974.*

Rationale: Federal Agencies should know and apply the principles of the Privacy Act of 1974 and incorporate them into investments.

Implications: A privacy notice that includes the purpose for the information request should be provided anytime the public provides or enters data. The public should be given the right to choose whether or not to provide information. When information is used for other purposes or those other than originally intended, an alternative privacy notice should be provided. Again, the public should be allowed to choose whether or not to provide the information. Protecting the privacy of the citizen is a tremendous burden and management must consider the potential uses of information. In addition, privacy information maintained by the Government will be properly secured.

Federal Enterprise Architecture Framework

Overview

The development and maintenance of an architecture is a continuing process of evaluating current conditions and seeking target solutions. The Federal Enterprise Architecture Framework articulates *how* the Federal Enterprise Architecture is developed and maintained. The Framework does not contain architecture content, but rather, is a place-holder for the content once developed.

What is the Federal Enterprise Architecture Framework?

The Federal Enterprise Architecture Framework is an organizing mechanism for managing the development and maintenance of architecture descriptions. The Federal Enterprise Architecture Framework also provides a structure for organizing Federal resources and describing and managing Federal Enterprise Architecture activities.

Eight components needed for developing and maintaining a Federal Enterprise Architecture were identified. A decomposition or drill-down process was performed on each component to achieve a further granularity of detail. The drill-down process resulted in a four-level Federal Enterprise Architecture Framework. Each level provides an understanding or frame of reference for the next. The first three levels, illustrate the progression of eight increasingly detailed components leading to a logical structure for classifying and organizing the descriptive representations of the Federal Enterprise in level IV.

Level I

Level I (the view from 20,000 feet) is the highest level of the Federal Enterprise Architecture Framework and introduces the eight components needed for developing and maintaining the Federal Enterprise Architecture. One component is external to the Framework, Architecture Drivers, the other seven are internal. As shown in exhibit 2, the flow of the Framework is from left to right and represents the continuous process of the Federal Enterprise Architecture.

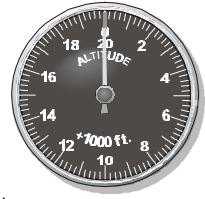
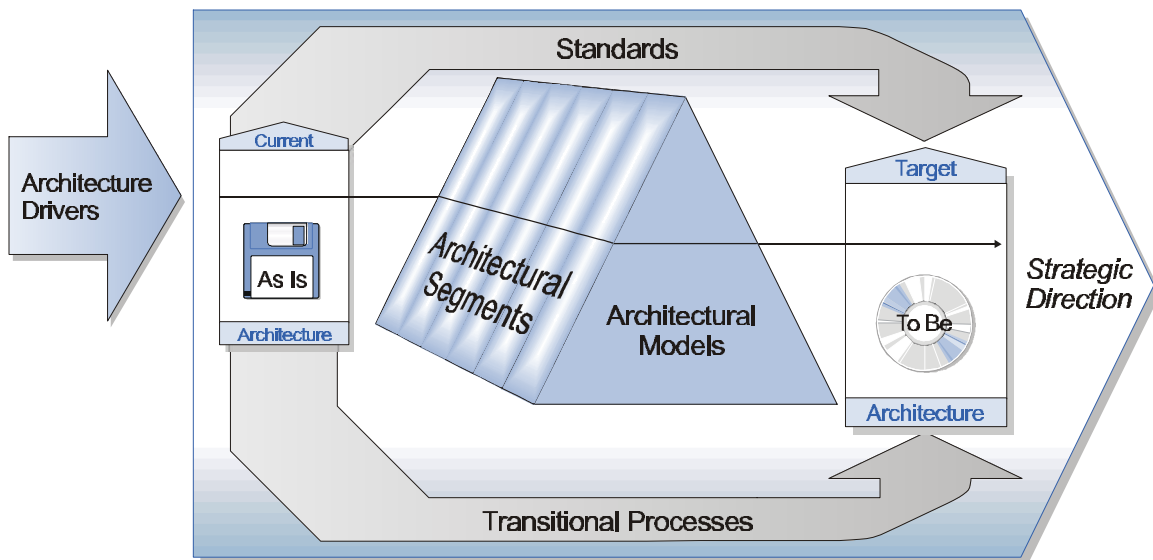


Exhibit 2, Federal Enterprise Architecture Framework, Level I



- ❑ **Architecture Drivers** - Represents an external stimulus that causes the Federal Enterprise Architecture to change.
- ❑ **Strategic Direction** - Ensures that changes are consistent with the overall Federal direction.
- ❑ **Current Architecture** - Represents the current state of the enterprise. Full characterization may be significantly beyond its worth and maintenance.
- ❑ **Target Architecture** - Represents the target state for the enterprise within the context of the *strategic direction*.

- ❑ **Transitional Processes** - Apply the changes from the current architecture to the target architecture in compliance with the architecture *standards*, such as various decision making or governance procedures, migration planning, budgeting, and configuration management and engineering change control.
- ❑ **Architectural Segments** - Focus on a subset or a smaller enterprise within the total Federal Enterprise.
- ❑ **Architectural Models** - Provide the documentation and the basis for managing and implementing changes in the Federal Enterprise.
- ❑ **Standards** - Include standards (some of which may be made mandatory), voluntary guidelines, and best practices, all of which focus on promoting interoperability.

Level II

Level II (the view from 10,000 feet) shows, at a greater level of detail, the business and design pieces of the Federal Enterprise Architecture and how they are related. Viewed horizontally, the top half of the Framework deals with the business of the enterprise, while the bottom half deals with the design architectures used to support the business. The relationship of business and designs is push/pull where the business pushes design and design (i.e., new developments in data, applications, and technology) pulls business to new levels of service delivery in support of business operations. Examples of design drivers are the Internet and electronic access to services by the public, creating challenges for the design to support the business mission.

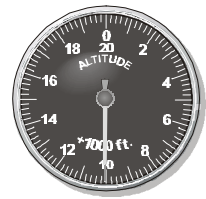
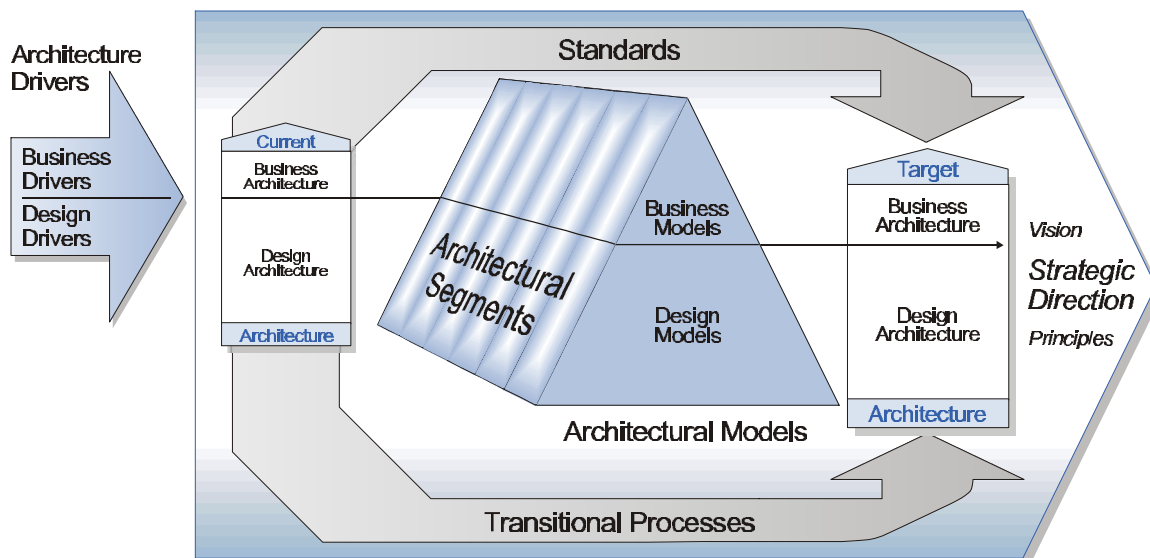


Exhibit 3, Federal Enterprise Architecture Framework, Level II



- ❑ **Architecture Drivers** - The change agents for the Federal Enterprise Architecture. There are two types of architecture drivers.
 - ❑ Business Drivers - Redefine core Federal business needs. For example, the need for public access, the Clinger-Cohen Act requiring the development of architectures and other new laws requiring electronic access or use of electronic signature, and the various re-invention of Government activities.
 - ❑ Design Drivers - Represent revolutionary ways of meeting Federal business needs. For example, the Internet.

- ❑ **Current Architecture** - The current state or baseline for the enterprise. The current architecture has two parts.
 - S Current Business Architecture - Defines the current business needs being met by the current design. *What are the business functions and capabilities now in place?*
 - S Current Design Architectures - Define the currently implemented or "as built" data, applications, and technologies used to support the current business needs. *What are the data structures, applications, and supporting technology in place that meet some or all of the business needs?*

- ❑ **Target Architecture** - The future desired state for the enterprise. The target architecture has two parts.
 - S Target Business Architecture - Defines the future business needs of the enterprise to be addressed through new or future designs. *What are the new or altered processes required by the business?*
 - S Target Design Architectures - Define the future data, applications, and technology to be used to support the future business needs. *What are the new or "to-be-built" data structures, applications, or supporting technology required to meet the above functionality or future support needs?*

- ❑ **Architectural Models** - The business and design architectures. As in most formalized information architectures, models are the basis for managing and implementing changes in the Federal Enterprise. They are the artifacts that describe, using appropriate notations, the detail specifications from which the applications and technology will be designed and implemented or purchased and installed.
 - S Business Models - Model the emerging business needs prompted by the business drivers. Modeling involves a common set of definitions, diagrams, and, sometimes, automated tools that facilitate understanding of business functions, information inputs, processes, and products.
 - S Design Models - Model the data, applications, and technology required to support the emerging business needs. Modeling can include diagrams, specifications, and technical drawings to aid in understanding data structures, applications, and supporting technologies.

- ❑ **Architectural Segments** - Consist of focused architecture efforts, such as a common administrative systems architecture or major Federal business areas (such as trade or grants), and represent a specific enterprise within the overall Federal Enterprise Architecture. Each architecture segment is composed of a current and target architecture, limited in scope by the focus of the segment.
- ❑ **Strategic Direction** - Guides the development of target architectures. The strategic direction incorporates the vision, a succinct and strategic statement describing the targeted end state for the architecture in 5 years, principles for guiding the architecture evolution, and goals and objectives for managing it and determining progress towards the vision.

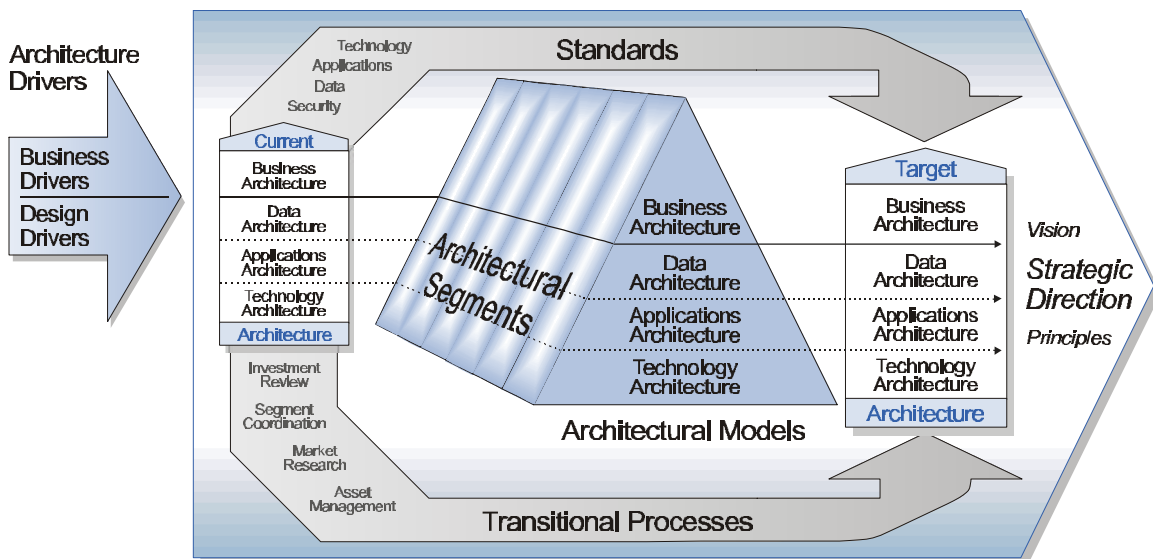
Level II further elaborates on the transitional processes (e.g., configuration management and engineering change control) that apply the changes from the current architecture to the target architecture in adherence to or compliance with the architecture standards. The standards may include mandatory standards, voluntary guidelines, and best practices that promote interoperability.

Level III

Level III (the view from 5,000 feet) expands the design pieces of the framework to show the three design architectures: data, applications, and technology.



Exhibit 4, Federal Enterprise Architecture Framework, Level III



- ❑ **Current Design Architectures** - The currently implemented designs used to support the current business needs. The current design architectures consist of the following three architectures.
 - S Current Data Architecture - Defines what data is in place to support the business (i.e., data models).
 - S Current Application Architecture - Defines what applications are in place to manage the data and support the business functions (i.e., application models).
 - S Current Technology Architecture - Defines what supporting technology is in place to provide an environment for applications that manage the data and support the business functions (i.e., technology models).

- ❑ **Target Design Architectures** - The future designs to be used to support the future business needs. The target design architecture consists of the following three architectures.
 - S Target Data Architecture - Defines the data needed to support the business (i.e., data models).
 - S Target Applications Architecture - Defines the applications needed to manage the data and support the business functions (i.e., applications models).
 - S Target Technology Architecture - Defines the supporting technology needed to provide an environment for applications that manage the data and support the business functions (i.e., technology models).

- ❑ **Design Models** - Three types of models used to define the enterprise.
 - S Data Models - Define the enterprise.
 - S Application Models - Define the applications that control the data.
 - S Technology Models - Define the current and target technology.

- ❑ **Architectural Segment** - A major business area of the overall Federal Enterprise. A segment is selected and defined in accordance with the Framework and its architecture information and models are loaded into the Federal Enterprise Architecture Repository. A segment can be considered to be an event-driven process (such as grants) that crosses the Federal Enterprise and possesses sufficient return-on-investment (ROI) to be considered for inclusion in the Federal Enterprise Architecture.

- ❑ **Transitional Processes** - Processes that support the migration from the current architecture to the target architecture. Examples include the following.
 - S Capital IT Investment Planning and Decision Making - Qualifying investments to be budgeted based on funding projections, ROI, cost benefits, and other criteria.
 - S Investment Management Review - Providing architecture information to support the investment review decision process.
 - S Segment Coordination - Coordinating the integration of the segment architectures into the Federal Enterprise Architecture. Configuration management and engineering change control processes must be in place.

- S** Market Research - Performing a periodic market scan to analyze and identify new and advancing technologies with potential benefits to business processes not previously available or are more efficient/cost effective.
 - S** Asset Management - Managing all Federal Enterprise Architecture-based infrastructure assets.
 - S** Procurement Practices - Aligning procurement activities with the architecture and other transitional processes.
 - S** Architecture Governance - Coordinating the effort to avoid confusion, gross misunderstanding, and rework.
- Standards** - All standards (some of which may be made mandatory), guidelines, and best practices. Some standards may be proven, while others are evolving. This component also includes configuration options for implementing the standards. Examples include the following.
- S** Security Standards - Apply to all levels of security from routine to classified.
 - S** Data Standards - Apply to data, meta data, and related structures.
 - S** Applications Standards - Apply to application software.
 - S** Technology Standards - Apply to the operating systems and platforms.



Level IV

Level IV (the view from 1,000 to 500 feet) identifies the kinds of models that describe the business architecture and the three design architectures: data, applications, and technology. It also defines enterprise architecture planning. At level IV, how the business architecture is supported by the three design architectures begins to evolve and be made explicit.

Enterprise architects and engineers have historically used models as their primary descriptive method. John Zachman and Steven Spewak are two of many recognized leaders in architecture conceptualization and enterprise architecture planning. This body of work is key at level IV in that it presents transitions from the general to a more specific set of methods and approaches.

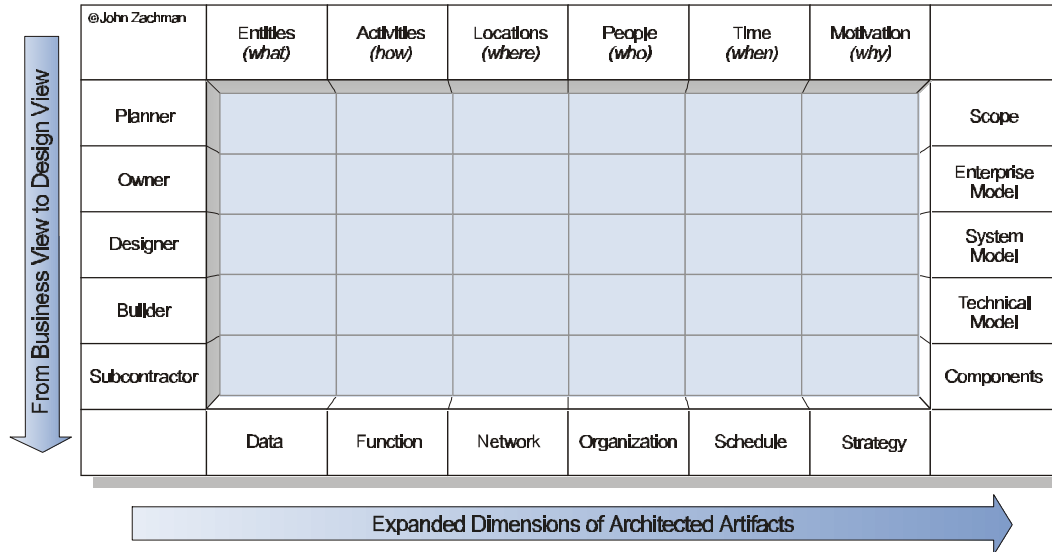
John Zachman is the author of the *Framework for Information Systems Architecture*, which is referred to as the Zachman Framework. It has received worldwide acceptance as an integrated framework for managing change in enterprises and the systems that support them. As it applies to enterprises, the Zachman Framework (refer to exhibit 5) is a logical structure for classifying and

What is the Zachman Framework as it applies to enterprise architecture?

The Zachman Framework provides a common context for understanding a complex structure. The Framework enables communication among the various participants involved in developing or changing the structure. Architecture is the glue that holds the structure together. The Framework defines sets of architectures that contain the development pieces of the structure.

organizing the descriptive representations (i.e., models) of an enterprise that are significant to its management and the development of its systems.

Exhibit 5, The Zachman Framework



The rows of the Zachman Framework represent different perspectives, which may be used to view a business (i.e., Planner, Owner, Designer, Builder, and Subcontractor views). The columns represent the product abstractions or the focus (i.e., Entities = *what*, Activities = *how*, Locations = *where*, People = *who*, Time = *when*, and Motivation = *why*).

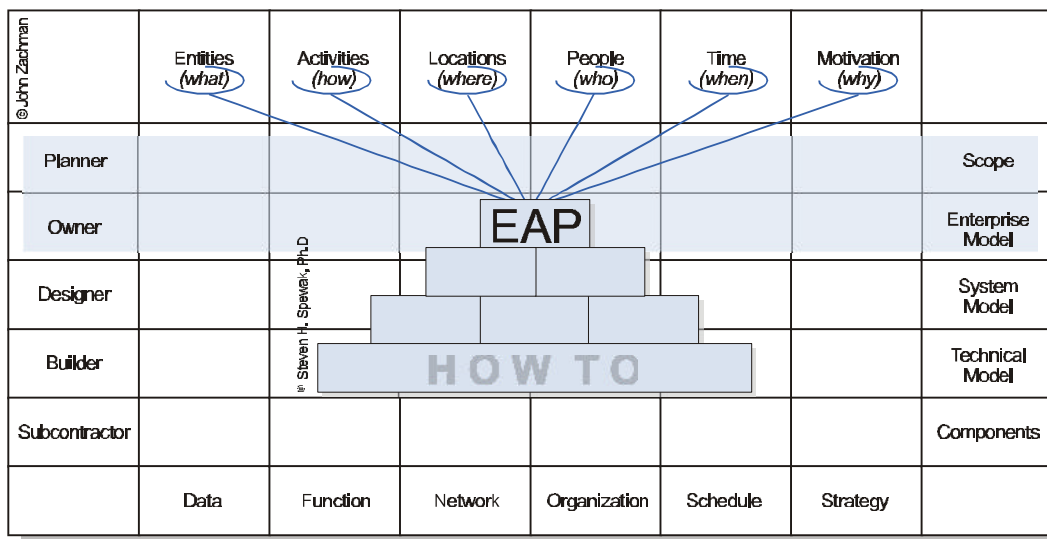
The Zachman Framework is a comprehensive, logical structure for descriptive representations (i.e., models) of any complex objects. It is neutral with regard to specific processes or tools used for producing the descriptions. The Framework, as applied to enterprises, is helpful for sorting out complicated technology and methodology choices and issues that are significant to general and technology management and identifying the kinds of models for a given project.

Dr. Steven Spewak is the author of *Enterprise Architecture Planning: Developing a Blueprint for Data, Applications, and Technology*. His approach to Federal Enterprise Architecture has helped organizations with modeling, business strategy planning, process improvement, data warehousing, and various support systems designs, data administration standards, object-oriented and information engineering methodologies, and project management. The Enterprise Architecture Planning (EAP) methodology is beneficial to understanding the further definition of the Federal Enterprise

What is Enterprise Architecture Planning (EAP)?

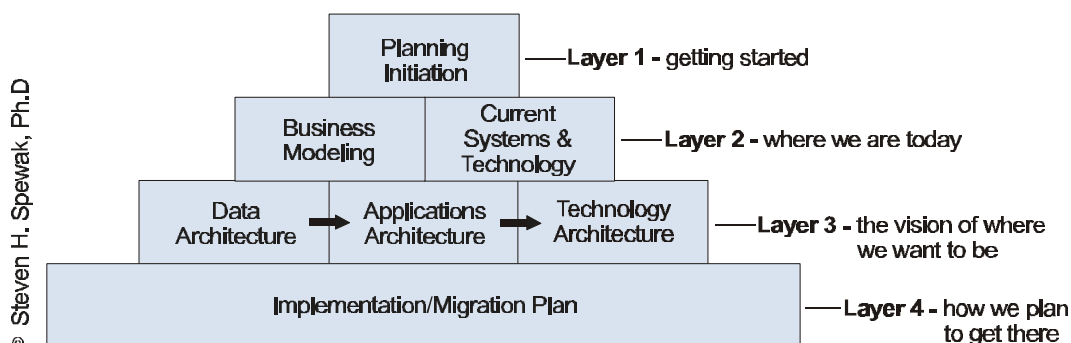
EAP is the process of defining architectures for the use of information in support of the business and the plan for implementing those architectures.

Architecture Framework at level IV. EAP is a *how to* approach for creating the top two rows of the Zachman Framework, Planner and Owner. The design of systems begins in the third row, outside the scope of EAP.



EAP focuses on defining *what* data, applications, and technology architectures are appropriate for and support the overall enterprise. Exhibit 6 shows the seven components (or steps) of EAP for defining these architectures and the related migration plan. The seven components are in the shape of a wedding cake, with each layer representing a different focus of each major task (or step).

Exhibit 6, Components of Enterprise Architecture Planning



Layer 1 - getting started

This layer leads to producing an EAP workplan and stresses the necessity of high-level management commitment to support and resource the subsequent six components (or steps) of the process.

- *Planning Initiation* - Covers in general, decisions on which methodology to use, who should be involved, what other support is required, and what toolset will be used.

Layer 2 - where we are today

This layer provides a baseline for defining the *to be* architecture and the long-range migration plan.

- *Business Modeling* - Compilation of a knowledge base about the business functions and the information used in conducting and supporting the various business processes.
- *Current Systems and Technology* - Definition of current application systems and supporting technology platforms.

Layer 3 - the vision of where we want to be

The arrows delineate the basic definition process flow: data architecture, applications architecture, and technology architecture.

- *Data Architecture* - Definition of the major kinds of data needed to support the business.
- *Applications Architecture* - Definition of the major kinds of applications needed to manage that data and support the business functions.
- *Technology Architecture* - Definition of the technology platforms needed to support the applications that manage the data and support the business functions.

Layer 4 - how we plan to get there

- *Implementation / Migration Plans* - Definition of the sequence for implementing applications, a schedule for implementation, a cost/benefit analysis, and a clear path for migration.

EAP defines the blueprint for subsequent design and implementation and it places the planning/defining stages into a framework. It does not explain how to define the top two rows of the Zachman Framework in detail but for the sake of the planning exercise, abbreviates the analysis. The Zachman Framework provides the broad context for the description of the architecture layers, while EAP focuses on planning and managing the process of establishing the business alignment of the architectures.

EAP is planning that focuses on the development of matrixes for comparing and analyzing data, applications, and technology. Most important, EAP produces an implementation plan. Within the Federal Enterprise Architecture, EAP will be completed segment enterprise by segment enterprise. The results of these efforts may be of Governmentwide value; therefore, as each segment completes EAP, the results will be published on the *ArchitecturePlus* web site (refer to appendix D, References).

Exhibit 7 describes with minor changes, how the Federal Enterprise Architecture Framework incorporates the five perspective rows (i.e., views) and the first three architectural artifacts or product abstraction columns of the Zachman Framework. Level IV shows the design architectures as column headings. The Planner and Owner rows focus on the business architecture definition and documentation. When completed, these rows make explicit what the enterprise business is and what information is used to conduct it (i.e., the business models).

Exhibit 7, Federal Enterprise Architecture Framework, Level IV

Perspectives	Data Architecture (entities = what)	Applications Architecture (activities = how)	Technology Architecture (locations = where)
Planner's View Objectives/Scope	List of Business Objects	List of Business Processes	List of Business Locations
Owner's View Enterprise Model	Semantic Model	Business Process Model	Business Logistics System
Designer's View Information Systems Model	Logical Data Model	Application Architecture	System Geographic Deployment Architecture
Builder's View Technology Model	Physical Data Model	System Design	Technology Architecture
Subcontractor's View Detailed Specifications	Data Definition "Library or Encyclopedia"	Programs "Supporting Software Components (i.e., Operating Systems)"	Network Architecture

Perspectives (Rows)

Each row represents a total view of the solution from a particular perspective. An upper row or perspective does not necessarily have a more comprehensive understanding of the whole than a lower perspective. Nor does an upper row decompose into greater detail in a lower row. Each row represents a distinct, unique perspective; however, the deliverables from each perspective must provide sufficient detail to define the solution at the level of perspective and must translate to the next lower row explicitly.

Each perspective must take into account the requirements of the other perspectives and the restraint those perspectives impose. The constraints of each perspective are additive. For example, the constraints of higher rows affect the rows below. The constraints of lower rows can, but do not necessarily affect the higher rows. Understanding the requirements and constraints necessitates communication of knowledge and understanding from perspective to perspective. The Framework points the vertical direction for that communication between perspectives.

Planner's View (Scope) - The first architectural sketch is a "bubble chart" or Venn diagram, which depicts in gross terms the size, shape, partial relationships, and basic purpose of the final structure. It corresponds to an executive summary for a planner or investor who wants an overview or estimate of the scope of the system, what it would cost, and how it would relate to the general environment in which it will operate.

Owner's View (Enterprise or Business Model) - Next are the architect's drawings that depict the final building from the perspective of the owner, who will have to live with it in the daily routines of business. They correspond to the enterprise (business) models, which constitute the designs of the business and show the business entities and processes and how they relate.

Designer's View (Information Systems Model) - The architect's plans are the translation of the drawings into detail requirements representations from the designer's perspective. They correspond to the system model designed by a systems analyst who must determine the data elements, logical process flows, and functions that represent business entities and processes.

Builder's View (Technology Model) - The contractor must redraw the architect's plans to represent the builder's perspective, with sufficient detail to understand the constraints of tools, technology, and materials. The builder's plans correspond to the technology models, which must adapt the information systems model to the details of the programming languages, input/output (I/O) devices, or other required supporting technology.

Subcontractor View (Detailed Specifications) - Subcontractors work from shop plans that specify the details of parts or subsections. These correspond to the detailed specifications that are given to programmers who code individual modules without being concerned with the overall context or structure of the system. Alternatively, they could represent the detailed requirements for various commercial-off-the-shelf (COTS), GOTS, or components of modular systems software being procured and implemented rather than built.

Focus (Columns)

The Framework is designed as a matrix. Down the left side are the perspectives, across the top are the different focuses or product abstractions (i.e., Entities = *what*, Activities = *how*, Locations = *where*) of these perspectives. Each focus asks a question. The way in which the questions are answered depends heavily upon the perspective. Put another way, the perspective necessitates the form and details required to make each answer explicit and understood.

The Zachman Framework includes three other columns not incorporated into the Federal Enterprise Architecture Framework at this time. Few formal modeling designs are available for the abstractions *who*, *when*, and *why*. This causes the descriptive representations (i.e., models) to be more theoretical and less empirical.

In summary, each perspective focuses attention on the same fundamental questions, then answers those questions from that viewpoint, creating different descriptive representations (i.e., models), which translate from higher to lower perspectives. The basic model for the focus (or product abstraction) remains constant. The basic model of each column is uniquely defined, yet related across and down the matrix.

Models (Cells)

The kinds of models or architectural descriptive representations are made explicit at the intersections of the rows and columns. An intersection is referred to as a cell. Because a cell is created by the intersection of a perspective and a focus, each is distinctive and unique. Since each cell is distinctive and unique, the contents of the cell are normalized and explicit per the perspective's focus.

Since the product development (i.e., architectural artifact) in each cell or the problem solution embodied by the cell is the answer to a question from a perspective, typically, the models or descriptions are higher-level depictions or the surface answers of the cell. The refined models or designs supporting that answer are the detailed descriptions within the cell. Decomposition (i.e., drill down to greater levels of detail) takes place within each cell.

If a cell is not made explicit (defined), it is implicit (undefined). If it is implicit, the risk of making assumptions about these cells exists. If the assumptions are valid, then time and money are saved. If, however, the assumptions are invalid, it is likely to increase costs and exceed the schedule for implementation.

John Zachman associates the term "sliver" with a portion of a cell or several cells. Slivers can be horizontal or vertical. If a sliver is horizontal within a cell or cells, the sliver could cover all the business areas. Horizontal slivers are often completed for planning and integration purposes. A sliver that is vertical within a cell or cells, covers one business area or some portion of the total business areas.

Perspectives	Data Architecture (<i>entities = what</i>)	Applications Architecture (<i>activities = how</i>)	Technology Architecture (<i>locations = where</i>)
Planner's View Objectives/Scope	List of Business Objects	List of Business Processes	List of Business Locations
Owner's View Enterprise Model	Semantic Model	Business Process Model	Business Logistics System
Designer's View Information Systems Model	Logical Data Model	Application Architecture	System Geographic Deployment Architecture
Builder's View Technology Model	Physical Data Model	System Design	Technology Architecture
Subcontractor's View Detailed Specifications	Data Definition "Library or Encyclopedia"	Programs "Supporting Software Components (i.e., Operating Systems)"	Network Architecture

Slivers

In the Federal Architecture, thinking of the cells in terms of slivers provides a way to relate to the segmentation of the Federal Enterprise into understandable parts without losing the definition of its total integration. The degree of granularity necessary for a cell is driven by the type of analysis or assessments that are of interest to the Federal Enterprise. Also, the cells that are defined or

made explicit are dependent upon the sliver. If, however, all the cells are not made explicit, there may be implications.

If cells are not made explicit enterprisewide, then other slivers in the same cell may not relate to or integrate with the previous slivers unless by chance, or unless steps are taken to pre-integrate ensuing efforts.

If higher rows are not made explicit, assumptions are made about them and the risk exists of building-in defects that must be rectified later, at much higher costs of time and money. Examples currently affecting the Federal Enterprise include the Year 2000 (Y2K) and cybersecurity investments.

If all the columns are not made explicit, then a short life is built into the implementation, because of the independent variables imbedded in a unitary implementation. If anything changes, everything must change. For example, in the past, data independence was not understood; therefore, data and process (instructions) were imbedded in the unitary implementation. To make a change in either the data or the process, the whole program had to be rewritten. If the data had been defined independently from the process, then the data could change along with the instructions that used the data. Or, the instruction could change and the data used by the instruction could use the new instruction.

The integration of all cell models in one row constitutes a complete architecture from the perspective of that row. The solution (or proposed development) from that perspective is complete; however, this does not mean the problem is solved or that the project is fully developed. A complete solution of a problem or its complete development can only be viewed as complete when the composite of all cells within the Framework are made explicit, as a whole. Complete models or architectures, being different relative to perspective and focus, are also additive and complementary.

It would be optimal to have all models enterprisewide, horizontally and vertically integrated at an excruciating level of detail. For the Federal Enterprise, this is not possible or feasible. As a segment architecture description is developed, certain cells might not be developed because of determinate constraints (e.g., time to complete the cell or devaluation of the contents of the cell). The incremental and continuous further evolution of the Federal Enterprise Architecture will decrease overall risk because cells will be made increasingly explicit over time. The adverse effect of making assumptions can be minimal or overpowering. The challenge for every Federal segment is to determine which cells (models) should be made explicit in support of the critical changing aspects of the enterprise and assume the risk of leaving the rest of the cells implicit.

The kinds of models contained in the first two rows (i.e., Planner, Owner) of exhibit 7, Federal Enterprise Architecture Framework, Level IV, define the business architecture of the Federal Enterprise. These kinds of models are considered essential and must be completed to develop a segment architecture description that can be commonly understood and integrated within and

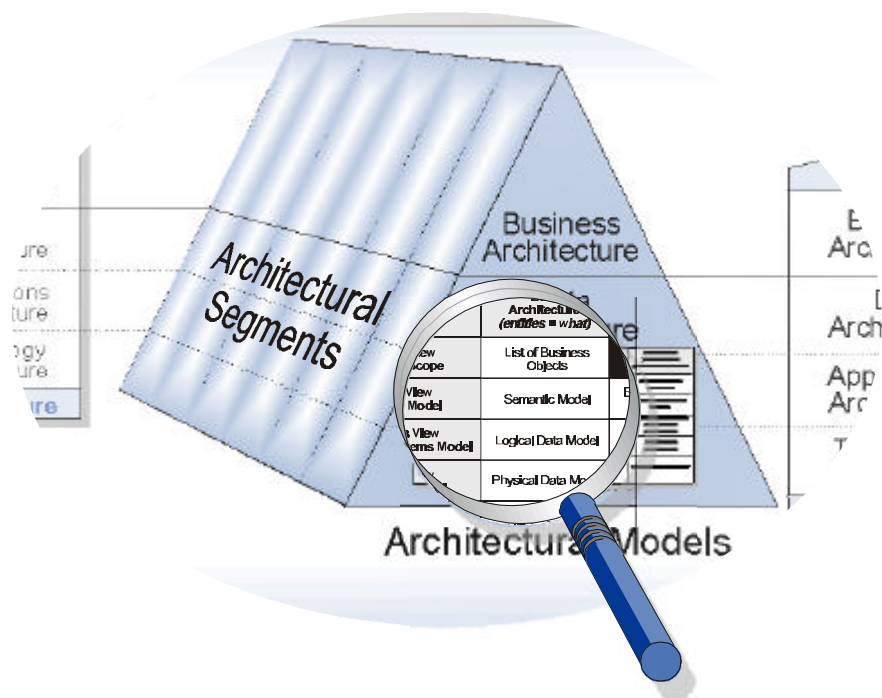
across the Federal Enterprise. The business requirements must be recognizable in the end product, and these kinds of business models must be developed by all architecture segments.

The models contained in the third, fourth, and fifth rows (i.e., Designer, Builder, Subcontractor) define the design architectures (i.e., data, applications, and technology) and support the business architecture. Appropriate models from these rows are developed depending on the purpose and objectives of the specific architecture segment effort.

Defined models are the basis for managing and implementing change in the enterprise in a timely manner. The Framework provides a logical structure for classifying and organizing the kinds of enterprise models that are significant to segment management and to the development of the supporting systems.

Exhibit 8 illustrates how the models described in level IV relate to the overall Federal Enterprise Architecture Framework.

Exhibit 8, Federal Architectural Models



Once defined, models establish a baseline of descriptive representations for managing change across the Federal Enterprise. After they are defined, reviewed, and approved or adopted, they must be stored. An automated model storage facility or Federal Enterprise Architecture Repository is required. An automated Federal Enterprise Architecture Repository will provide easy access to and referencing of design components, pattern searches, structure changes, currency, and configuration management and version control. In addition, this automated repository will assist in communicating enterprise architecture concepts to varied audiences including regulatory, legislative, management, and industry partners.

Why are the models important?

Defining the model is important because no organization should have to determine what the models are to identify what needs to be changed. The Framework is important because no organization should have to build the models from scratch wasting valuable time and effort.

The success of the Federal Enterprise Architecture depends on managing (enforcing) the development process and implementing the architecture descriptions. Business rules must be enforced consistently from implementation to implementation to coordinate and/or change behavior throughout the enterprise. Models must be defined logically, independent of technology constraints, such that the implementation technology can be changed with minimum disruption and cost. Change must be incorporated as a design and management criteria, such that any aspect of the enterprise can be maintained relevant in a dynamic environment. Exhibit 9 describes the models of the Federal Enterprise Architecture Framework.

Exhibit 9, Federal Enterprise Architecture Framework Models			
Perspectives	Data Architecture (<i>entities = what</i>)	Application Architecture (<i>activities = how</i>)	Technology Architecture (<i>locations = where</i>)
Planner (<i>scope</i>)	<u>List of Business Objects</u> A list of objects (or things, or assets) in which the enterprise is interested. The list is a fairly high level of aggregation. The model defines the scope, or boundaries, of the models of objects significant to the enterprise (i.e., the rows beneath it).	<u>List of Business Processes</u> A list of processes or functions that the enterprise performs, or the transformation of enterprise inputs into outputs. The list is a fairly high level of aggregation. The model defines the scope, or boundaries, of the models of processes the enterprise performs (i.e., the rows beneath it).	<u>List of Business Locations</u> A list of locations in which the enterprise operates. The list is a fairly high level of aggregation. The model defines the scope, or boundaries, of the models of locations that are connected by the enterprise (i.e., the rows beneath it).

Exhibit 9, Federal Enterprise Architecture Framework Models

Perspectives	Data Architecture (<i>entities = what</i>)	Application Architecture (<i>activities = how</i>)	Technology Architecture (<i>locations = where</i>)
Owner (enterprise)	<u>Semantic Model</u> A model of the actual enterprise objects (i.e., things, assets) that are significant to the enterprise. Typically, the semantic model would be represented as an entity/relationship model and would be at a level of definition expressing concepts (i.e., terms and facts) used in the significant business objectives/strategies that would later be implemented as business rules.	<u>Business Process Model</u> A model of the actual business processes that the enterprise performs, independent of any system or implementation considerations and organizational constraints. It can be represented as a structured methods-style model expressing the business transformations (processes) and their inputs and outputs.	<u>Business Logistics System</u> A model of the locations of the enterprise and their connections (i.e., voice, data, post or truck, rail, ship, etc.). It would include identification of the types of facilities at the nodes like branches, headquarters, warehouses, etc.
Designer (information systems)	<u>Logical Data Model</u> A model of the logical representation of the objects of the enterprise about which it records information, in either automated or non-automated form. It would be represented as a fully attributed, keyed, normalized entity relationship model reflecting the intent of the semantic model.	<u>Application Architecture</u> A model of the logical systems implementation (manual and/or automated) supporting the business processes. It expresses the human and machine boundaries. The model could include the controls and mechanisms, as well as the inputs and outputs to the logical systems representations of the system functions/processes.	<u>System Geographic Deployment Architecture</u> A logical model of the system implementation of the business logistics system depicting the types of systems facilities and controlling software at the nodes and lines (e.g., processors/operating systems, storage devices/DBMS, peripherals/drivers, lines/line operation systems, etc.).

Exhibit 9, Federal Enterprise Architecture Framework Models			
Perspectives	Data Architecture (<i>entities = what</i>)	Application Architecture (<i>activities = how</i>)	Technology Architecture (<i>locations = where</i>)
Builder (<i>technology</i>)	<u>Physical Data Model</u> A technology constrained, or physical representation of the objects of the enterprise. The representation style of this model would depend on the technology chosen for implementation. If relational technology is chosen, this would be a model of the table structure required to support the logical data model in a relational-style model. In an object-oriented notation, this would be a class-hierarchy/association style model.	<u>Systems Design</u> Technically, this would not be considered a model but a design. At a high level of abstraction, it would be a structure chart and in its detail, action diagram-style expressions that would constitute the implementation of the logical systems, or application architecture. In object-oriented notation, this would be the methods and their realization.	<u>Technology Architecture</u> The physical depiction of the technology environment for the enterprise showing the actual hardware and systems software at the nodes and the lines and their systems software, including operation systems and middleware.
Subcontractor (detailed specifications)	<u>Data Definition</u> “Library or Encyclopedia” The definition of all the data objects specified by the physical data model and would include all the data definition language required for implementation.	<u>Programs</u> “Supporting Software Components (i.e., Operating Systems)” The programs derived from the action diagram-style or object-style specifications for the implementation. Given the appropriate engineering design, these could become the pre-fabricated components that could be assembled into more than one implementation.	<u>Network Architecture</u> The specific definition of the node addresses and the line identification.

The remaining three product abstraction columns of the Zachman Framework: *who*, *when*, and *why* are not incorporated into the Federal Enterprise Architecture Framework. The state of the art is still somewhat limited for these focus columns; however, the dramatic changes taking place are forcing attention on all the descriptive representations for enterprises. The dramatic increases in enterprise complexity and the continued escalation of the rate of change are beginning to drive the state of the art in architecture process and methodology. Although there are not commonly acknowledged standard notations for many of the models, there are substantive proposals to the information knowledge management community at large in almost every case. Many of the standards bodies including Institute of Electrical and Electronics Engineers (IEEE) and American National Standards Institute (ANSI) are pursuing various architectural standards.

As the state of the art advances, new insights are gained, and the terminologies and languages of information architecture become more precise and standardized. For now, the CIO Council acknowledges the importance of adherence to the Framework and recognizes the importance of the contents of the remaining three columns (i.e., *who*, *when*, and *why*), which will be considered for incorporation into the Federal Enterprise Architecture Framework in the near future. Refer to appendix B, Remaining Models, for descriptive representations of the three remaining focus columns.

Framework Summary

Enterprise architecture is the principle structural mechanism for establishing a basis for assimilating high rates of change, advancing the state of the art in enterprise design, managing the knowledge base of the enterprise, and integrating the technology into the fabric of the enterprise. Enterprise architecture is cross-disciplinary, requiring diverse skills, methods, and tools within and beyond the technology community.

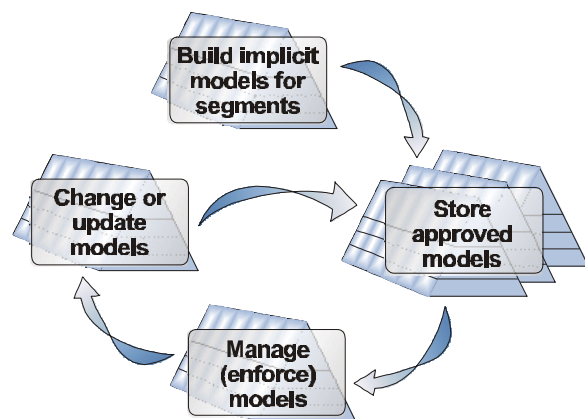
The Federal Enterprise Architecture Framework establishes a universal language to facilitate communication, research, and implementation of enterprise architecture concepts across the Federal Enterprise. The Framework is a valuable cognitive management tool, central to making long-term and short-term trade-offs inherent when managing change in a complex enterprise. Instantiation of this Framework will allow the Federal Government to do the following.

- ☐ Organize Federal information including common data and business processes on a Federalwide (enterprisewide) scale
- ☐ Promote information sharing throughout the Federal Enterprise and within segments
- ☐ Help the Federal Enterprise develop architecture descriptions
- ☐ Help the Federal Enterprise move more quickly toward developing new and improved processes

How is the target architecture achieved?

The ultimate target architecture would be an enterprisewide horizontal and vertical integrated architecture at an excruciating level of detail. While this is not possible overnight or even in several years, the creation of the Federal Enterprise Architecture, made increasingly explicit over time through the description of segment architectures, will lower risks for Federal Enterprise Architecture-wide disruptive impacts like Y2K and cyber-protective retrofits. Stated simply, the solution to achieving as close to the ultimate target or vision architecture as possible is as follows.

- ☐ Build Models
- ☐ Store Models
- ☐ Manage (enforce) Models
- ☐ Change Models



Returns, Risks, and Costs of the Federal Enterprise Architecture

Establishing the Federal Enterprise Architecture will rectify the current lack of alignment, integration, and the ability to respond quickly to change. Services to the public and efficient Governmental processes can continue to be increased at dramatically lower total lifecycle costs.

Returns

Better Information

By providing organized Federal information and promoting information sharing, the Federal Enterprise Architecture will maximize the benefits and impact of information technology across the Federal Enterprise. The availability of better Federalwide information is ensured by the following aspects of the Federal Enterprise Architecture.

- ❑ **Mission Alignment** - The Federal Enterprise Architecture has a strategic planning component to ensure strategic alignment with the Federal vision.
- ❑ **Cross-Agency Business Needs** - The Federal Enterprise Architecture promotes the sharing of information throughout the Federal Enterprise, across Federal organizations, and with other entities (i.e., State, local, international, customers, stakeholders, etc.).
- ❑ **Re-invention Initiatives** - The Federal Enterprise Architecture defines common Federal business needs and defines common processes required to support these needs. These common processes can be leveraged to support and institutionalize Federal re-invention initiatives.
- ❑ **Data Collection and Data Quality** - The Federal Enterprise Architecture defines a consistent method for collecting data, which can improve data quality and reduce the data collection burden, all with commensurate cost effects and efficiency.
- ❑ **Public Access** - The Federal Enterprise Architecture promotes a consistent method for organizing and categorizing Federal Architecture information, allowing for consistent presentation of Federal information through the Internet.

Facilitated Decision Making

The Federal Enterprise Architecture can assist Federal Agencies in developing their information technology investment processes through commonly defined Federal solutions.

- ❑ **IT Capital Investment Planning** - The Federal Enterprise Architecture will increasingly define target directions for future IT acquisitions. This information facilitates Federal capital investment decision making.
- ❑ **Faster Response to Changing Business Needs** - The Federal Enterprise Architecture will contain information (blueprints) on the current IT environment. With this information at hand, Federal decision making can progress faster, lengthy fact gathering steps are minimized, and integrated solutions are easier to conceptualize, visualize, and analyze.
- ❑ **Gap Analysis** - The Federal Enterprise Architecture blueprints, or descriptions, highlight areas of overlooked or missing information, which translate into new business initiatives and innovative IT solutions. For example, technology-supported distance learning, Governmentwide via the Internet, may be an opportunity for new business.
- ❑ **Knowledge Base** - The Federal Enterprise Architecture descriptions provide an available pool of knowledgeable IT solution sets as resources for quick and informed IT decision making.

Potentials for Cost Reduction

Cost reductions can be realized by assisting Federal organizations in developing architectures and reducing the need to redevelop common business support solutions from scratch.

- ❑ **Economies of Scale** - The Federal Enterprise Architecture identifies common Federal activities across organizations, highlighting potential areas for cost savings through reuse of models, diagrams, and whole implementations through collaboration.
- ❑ **Resource Sharing** - The Federal Enterprise Architecture highlights areas for potential resource sharing of Federal IT staff and other technical support, including contract services and purchased solutions.
- ❑ **Market Research** - The Federal Enterprise Architecture effort requires constant monitoring of emerging technologies for potential enterprisewide use and analyzing impacts. This research can be shared across Federal Agencies within common business lines, relieving each of the added burden and cost of independently collecting and evaluating this information.

Risks

The Federal Government could risk allocating too much time and resources to an enterprise architecture description effort yielding potentially little return at significant cost. For this reason, the CIO Council chose the segment approach for establishing the Federal Enterprise Architecture, leveraging, ongoing crosscutting initiatives. Still, there is no question that the Federal Enterprise Architecture effort will be a continuing process requiring a substantive investment in time and effort.

The Federal Enterprise Architecture program requires technical and acquisition expertise. The Architecture is too strategically important to follow a sporadic or ad hoc process, as is the case with many software development efforts at the initial level of the capability maturity model (CMM).

The Federal IT community must keep its eyes on the future and its basic principles rather than near-term objectives and achievements. Without the Federal Enterprise Architecture, the multiple business areas (i.e., Federal segments) will probably never become interoperable or establish and adhere to open and flexible standards. Continuing negative consequences will impact the Federal IT community's ability to provide flexible services and responses to the public, and respond to unknown and endemic systems integration problems and needs.

The Federal Government has to pay up-front for the right to exercise options in the future. In the past, the Federal IT community has often settled for cheaper, less permanent solutions, rather than focusing on options that provide increased future maneuverability. Often planning and engineering rigor have been sacrificed to political mandates to show progress quickly. In the long run, this approach wasted resources and left the next generation of information technology managers and CIOs a legacy of problems.

Concern over territoriality and loss of autonomy may impede the Federal Enterprise Architecture effort, as independent-minded IT organizations may not wish to participate in collaborative efforts, particularly since long-term, realignment of Agency functions and responsibilities could be a result.

It may be difficult to reach agreement on common, cross-Agency models and standards, which are necessary to ensure interoperability. When example-detailed models are developed, common frame of reference and interoperability between Federal segments will result. Developed models can be used repeatedly between major business areas (i.e., Federal segments). The IT community must continuously leverage its information technology products and, at each step, revise adding value.

Costs

Start-up Architecture Development Costs

Start-up costs for developing the Federal Enterprise Architecture effort can be significant because substantial effort is required to define and understand the current architecture environment and institutionalize the Federal Enterprise Architecture Framework for management, decision making, and continuing research and use. The Federal Government has no current enterprisewide architecture information, nor a repository in which to put. For each Federal segment, current architecture information must be developed incrementally, from scratch, or leveraged from existing collaborative efforts, such as Federal grants, trade duties, Joint Financial Management Improvement Program (JFMIP), Office of Personnel Management (OPM) systems initiative, and others. The Federal Government must somehow institutionalize a mechanism and organizational focal point for creating, managing, and overseeing the Federal Enterprise Architecture. While this is recognized by the CIO Council, further actions are deferred pending further proof of concept of the Federal Enterprise Architecture and processes.

"If you fail to invest in a well-defined information architecture, you will cripple the knowledge infrastructure that is the foundation for the intelligent learning organization."

— Larry P. English

The primary costs include the preparation of architecture descriptions, staffing, and continued development of this Framework and maintenance of the architecture descriptions.

Recurring IT Operations Costs

Case studies in industry show that recurring operations costs should decrease as more of the current enterprise architecture is captured and more of the target enterprise architecture is defined and implemented. With good architectural information, the Federal Government can realize cost savings from better informed decision making and the economies of scale resulting from good architectural design implementations.

"Data residing in a single sharable database has more than 43 times the value of the same data residing in 43 redundant databases. The redundancy actually diminishes its value because of costs to capture or interface it 43 times coupled with the costs of inconsistent data that will occur in such unmanaged information environments."

— Larry P. English

Exhibits 10 and 11 show the costs of maintaining 43 different programs and tables in a non-architected environment (i.e., systems approach) as opposed to maintaining one enterprise program and database file in an architected environment (i.e., resource approach). Clearly, it costs more to develop and maintain systems in a non-architected environment. Exhibits 10 and 11 do not include costs associated with poor quality data, rework, and costs of providing poor service to the public.

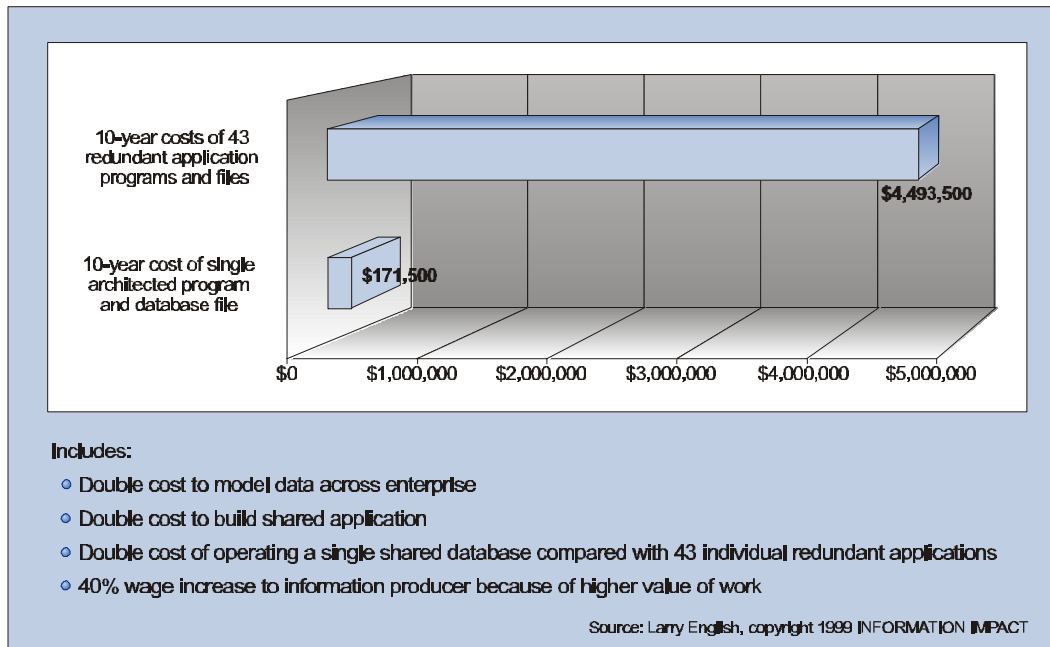
Exhibit 10, Redundant Systems Approach vs. Resource Approach Development Costs

Systems Approach:						
43 Different programs to create 1 fact in 43 different databases*						
Cost of 1 program (over life)		\$20,000	43	\$860,000		
Cost of 1 table (over life)		\$12,000	43	\$516,000		
Total development/maintenance expenses						\$1,376,000
Data entry - 1 person per year x ¼ time	\$25,000	\$6,250	43	\$268,750		
IT operation cost per year (1 program + 1 database)		\$1,000	43	\$43,000		
Total operational expenses				\$311,750	10	\$3,117,500
10-Year Total Cost						\$4,493,500
Resource Approach:						
Cost of 1 enterprise program*		\$40,000	1	\$40,000		
Cost of 1 enterprise database file*		\$24,000	1	\$24,000		
Total development expenses						\$64,000
Data entry - 1 person per year x ¼ time	\$35,000	\$8,750	1	\$8,750		
IT operation cost per year (1 program + 1 database)		\$2,000	1	\$2,000		
Total operational expenses				\$10,750	10	\$107,500
10-Year Total Cost						\$171,500

* Assumes 2 times the amount of time to define requirements for all consensus vs. one functional unit

Source: Larry English, copyright 1999 INFORMATION IMPACT

Exhibit 11, Redundant Systems Development Costs



Opportunity Costs

By deploying staff and resources to develop a Federal Enterprise Architecture, Federal organizations forego other investment opportunities. Staff and resources used for Federal Enterprise Architecture development and maintenance are not available for other activities that are deemed more critical. Currently, several areas are viewed as such, these relegate the Federal Enterprise Architecture to a lower priority level.

An architecture that allows for a degree of interoperability among systems can provide tremendous future integration opportunities. Without the upfront planning, including developing an enterprise architecture, it is not possible to exercise future options.

"You have to invest now in architecture to exercise the option to have interoperability between systems at a later date."

— Bernard H. Boar

Conclusion

With a Federal Enterprise Architecture to guide investment decisions, there is a systematic way to preclude inconsistent system designs and development decisions and the resulting sub-optimal performance and associated costs. The impact to the Federal Government is the ability to share complete and consistent information across the enterprise and respond effectively to change. In contrast, without a Federal Enterprise Architecture, a variety of continuing symptoms will plague these efforts.

- ❑ **Inability to Share Information** - Without standards and guidelines, Federal organizations will continue to experience difficulties in sharing business information through technology mediums, such as word processing documents, e-mails, databases, and other applications, which in turn, require redundancy and add costs. The knowledge infrastructure is not in place to allow knowledge management. Public expectations for a simple interface to the Federal Government will be elusive.
- ❑ **Incomplete Information** - Because the Federal Government does not have a Federal Enterprise Architecture, incomplete information for decision making, even in the instances of truckloads of data, continues to be the norm.
 - S Retrieval of data or knowledge management is difficult because Federal cross-Agency business information is incomplete, unorganized, and excessively redundant due to existing independent stovepipe systems.
 - S Federal IT capital planning investment information is incomplete, due to the lack of information on Federal current architecture environment, ongoing well-coordinated IT market research, and a Federal target architecture. Individual Agencies are pursuing multiple solutions in areas of electronic commerce, authentication, smart cards, encryption, and others.
 - S Without a Federal Enterprise Architecture to support business and design decision making, the Federal Government continually faces an increasing risk of making disparate, inappropriate, and costly decisions due to incomplete information. The Federal Government has settled for less and has grown accustomed to poor quality and incomplete data.
- ❑ **Slow Response to Change** - Without the Architecture, the Federal Government will continue to be slow to respond to change stimulus. For example, the Y2K activity would have benefitted greatly from having a Federal Enterprise.
 - S Faster identification of impacted areas of the Federal Enterprise Architecture through evaluation of current architecture information

- S Faster containment of the problem by using the Federal Enterprise Architecture decision-making body to quickly define data standards for implementation
- S Faster mobilization into action through an existing and educated Federal Enterprise Architecture decision-making infrastructure

Potentially, the same are true for the cybersecurity issues under the PDD-63, Critical Infrastructure Protection, initiative.

The Federal Enterprise Architecture Framework is expected to help Federal segments develop and maintain architecture descriptions by providing explicit languages of terms for communication, a repository structure, an organizing mechanism for collaboration, and support towards more effective IT investment planning and decision making.

This Framework represents an enterprise architecture, which, for Federal purposes, defines the enterprise as the Federal Government. A Federal segment is also referred to as an enterprise, but a Federal segment cannot stand alone and will be interoperable with other Federal segments to one degree or another. Federal Agencies can use the same approach, based on this Framework model, to more narrowly define the enterprise as their own Agency and respond to the Clinger-Cohen Act, which requires an enterprise IT architecture for each organization. Federal Agencies can choose to use this Framework as is or modify it to meet their unique needs. In any case, the Framework can help to jumpstart architecture development efforts of Federal organizations, if desired.

Developing an enterprise architecture is a complex undertaking, further complicated by the lack of consistent terms for communication. Federal Agencies that have started architecture development efforts have quickly recognized the need for a common set of terms. Architecture terminology is used in different ways with widely varying meanings. This Framework clarifies, for the Federal community, many previously vague or ill-defined terms and standardizes the meanings of other varying terminologies as they relate specifically to a Federal Enterprise Architecture. At the same time, however, it can also be used by Federal Agencies to describe their architectures. As such, the Framework serves as a Federalwide tool set for communicating architecture concepts and issues. (Refer to appendix C, Glossary of Terms, for an alphabetical listing of architecture terms used within the Framework.)

As an asset management tool, this Framework can be used to develop and maintain Federal strategic information assets, which are the architecture descriptions, or blueprints, of the enterprise current and target architectures. As these assets are developed incrementally through architecture segments, they are added to the Federal asset base. As the asset base grows over time, it becomes increasingly valuable and yields steadily higher returns. A quality architecture will have a consistent way of developing these assets, and a consistent way of making the asset information available. To use this Framework effectively, the CIO Council will support the

development and continuous updating of the architecture descriptions including models necessary for consistent asset development and a repository for organizing, storing, and presenting them.

When used as an organizing mechanism for collaboration, this Framework can support the individual architecture processes and activities of many Federal segments. The Framework supports incremental development of architecture segments, which in turn supports collaboration for the purpose of developing these segments. Collaboration can occur between Federal segments, as well as within a Federal segment. Federal segments can benefit from peer collaboration through resource sharing. Through collaboration, Federal segments can share knowledge and services and make use of economies of scale.

This Framework can help Federal segments quickly complete the first step towards developing their architectures and because Federal segment architectures are critical for IT investments planning, this Framework can also help them move faster towards implementing compliant IT investment processes.

In conclusion, it has been said by many that a Federal Enterprise Architecture is a pipe dream and a waste of time and effort; however, the CIO Council strongly disagrees. As demonstrated, herein, by their cumulative and voluntary efforts, the CIOs have defined a realistic and reusable approach, the Federal Enterprise Architecture Framework, for creation of the Federal Enterprise Architecture. The CIO Council believes that if the Federal Government continues to do what we have done (i.e., build non-architected solutions), we will continue to get what we have (i.e., a non-interoperable, expensive, and ever challenging tangle of data, applications, and technology).

"The cost justification for information quality initiatives is made from analyzing and quantifying the costs of non-quality information. You must know the costs of the status quo. These costs of process failure, business rework, decreased productivity, redundancy upon redundancy, have been accepted by business as a normal cost of doing business. When management recognizes that the costs of information scrap and rework, process failure, and lost and missed opportunity are crippling the bottom line, changes will be made."

— Larry P. English

Appendix A

**Petition to Be Designated
A Federal Information Architecture Segment**

Title of the Project:

Acronym:

1. Project Management Information

Name:

Job Title:

Organization Name:

E-mail Address:

Work Phone:

Fax:

(If you wish to provide additional names, please copy the above fields and insert the additional names.)

2. Do you have a mission statement? Please provide it below, or attach it to this document.
3. Please check those items that are partially completed, completed, or that you intend to do in the future, and provide the percent completed and the estimated completion date.

- ☐ Concept of Operations, _____% Completed, Estimated Completion Date_____.
- ☐ Project Plan/Strategy, _____% Completed, Estimated Completion Date_____.
- ☐ Acquisition Strategy, _____% Completed, Estimated Completion Date_____.
- ☐ Feasibility Study, _____% Completed, Estimated Completion Date_____.
- ☐ General Requirements (basically a listing of requirements), _____% Completed, Estimated Completion Date_____.
- ☐ Market Research, _____% Completed, Estimated Completion Date_____.
- ☐ Alternatives Analysis (Cost/Benefit or Risk and Sensitivity Analysis), _____% Completed, Estimated Completion Date_____.
- ☐ Market Survey, _____% Completed, Estimated Completion Date_____.
- ☐ Prototype/Pilot Evaluation, _____% Completed, Estimated Completion Date_____.
- ☐ Migration Analysis, _____% Completed, Estimated Completion Date_____.
- ☐ Security and Contingency Plans, _____% Completed, Estimated Completion Date_____.
- ☐ Data Management Plan, _____% Completed, Estimated Completion Date_____.
- ☐ System Test and Acceptance Plans, _____% Completed, Estimated Completion Date_____.
- ☐ Quality Assurance and Configuration Plans, _____% Completed, Estimated Completion Date_____.

☐ Enterprise Architecture Planning, _____% Completed, Estimated Completion Date _____.

Data Architecture

☐ List of Business Objects, _____% Completed, Estimated Completion Date _____.

☐ Semantic Model, _____% Completed, Estimated Completion Date _____.

☐ Logistical Data Model, _____% Completed, Estimated Completion Date _____.

☐ Physical Data Model, _____% Completed, Estimated Completion Date _____.

☐ Data Definition, _____% Completed, Estimated Completion Date _____.

Applications Architecture

☐ List of Business Processes, _____% Completed, Estimated Completion Date _____.

☐ Business Process Model, _____% Completed, Estimated Completion Date _____.

☐ Application Architecture, _____% Completed, Estimated Completion Date _____.

☐ System Design, _____% Completed, Estimated Completion Date _____.

☐ Programs, _____% Completed, Estimated Completion Date _____.

Technology Architecture

☐ List of Business Locations, _____% Completed, Estimated Completion Date _____.

☐ Business Logistics System, _____% Completed, Estimated Completion Date _____.

☐ System Geographic Deployment Architecture, _____% Completed, Estimated Completion Date _____.

☐ Technology Architecture, _____% Completed, Estimated Completion Date _____.

☐ Network Architecture, _____% Completed, Estimated Completion Date _____.

4. How will this project:
 - Improve operational needs?
 - Improve service to customers?
5. What is the scope?
6. Outline your organizational structure or governance. Include information on boards, committees that directly influence project decision making.
7. Cite primary references, that is, legislation, Presidential initiatives, or the level of executive interest in the project. What are the political issues and pressures?
8. How many Agencies are involved in the project? Please list the Agencies and categorize the list by Federal, international, State, and local.
9. What is the current system development lifecycle stage of the project and/or indicate the percent complete.

10. Which levels of the Federal Enterprise Architecture Framework does the project involve?
11. Are you following any particular system development lifecycle (SDLC), including possibly prototyping, and/or methodologies? Please describe the SDLC. Also, check one of the following if you are using this techniques to evaluate the concept of operations.

☐ Laboratory Implementation

☐ Prototype/Pilot

☐ Initial Field Implementation

☐ Complete Implementation

12. Which Agency provides primary support? What kind of support?
13. How much has been invested in the project to date?
14. What resources are needed to complete the project?
15. What Agency(s) is providing the funding?
16. Briefly describe the problems with funding.
17. Explain the potential benefits for the Federal Government of associating your project with the CIO Council's Federal Enterprise Architecture effort.
18. Have you taken any architecture training, including, among others, that based on the concepts of John Zachman and Dr. Steven Spewak? Have you read John Zachman's articles and Dr. Spewak's text on Enterprise Architecture Planning? Does the project staff have experience with constructing data, applications, and technology models?
19. Do you have sufficiently trained and experienced staff to handle the project; for example, if data is involved, do you have an experienced data modeler?
20. Are you using automated tools? What are they?
21. Are you complying with any standards? What are they?
22. What is the schedule, particularly the planned duration of the project in terms of months?
23. What contractors have provided support and briefly describe this support?
24. What additional contract support is planned?
25. What is the Projected Net, Risk Adjusted Return on Investment (ROI)?
- Note: ROI is a financial measure that when applied to the IT arena, must include the entire lifecycle of the project. To determine ROI, divide the investments by revenue. Investments include all expenses, upgrades, and maintenance for the outyears. Revenue includes all the benefits over the life of the project. The estimated dollar value of the risks is subtracted from the revenue.*
26. Is the project divided into major phases? What are they? Do the responses in this petition address the entire project or a specific phase of the project?
27. What are the risks? Please elaborate on these risks and rate them 1-5. (1=Low Risk and 5=Extremely Risky) procedures? Will it work?)

☐ Project Plan and Market Concept Risk

How risky are your schedule and costs estimates? Is everyone who needs to be "on-board" cooperating with the project? Do you have a marketing plan to ensure that you have full support of all Departments and independent Agencies with a vested interest in the project?

☐ Technology Risk

What are the risks associated with technical difficulty and complexity? Are there standards and procedures? Will it work?



Organizational/Implementation Risk

Could the current commitments to existing system(s) impact the project? How will the Departments and staff be affected? Do you have the right staff and training?



Economic/Budget Risk

Is the project costed correctly and does it consider inflation? Will the length of development (include risk with schedule slippage and overruns) increase costs? Are the funds allocated correctly?



Results Risk

Can the project achieve the goals and objectives? Is obtaining results more important than the schedule and costs? Will the schedule and allocation of funding threaten the quality of the results?

Appendix B

Remaining Models

Perspectives	People (who)	Time (when)	Motivation (why)
Planner (scope)	<u>List of Organizations Important to the Business</u> A list of organizations to which the enterprise assigns responsibility for work. The list is at a fairly high level of aggregation. It defines the scope or boundaries of the models (i.e., the rows beneath it).	<u>List of Events Significant to the Business</u> A list of events to which the enterprise responds relative to time. The list is at a fairly high level of aggregation. It defines the scope or boundaries of the models (i.e., the rows beneath it) of time significant to the enterprise.	<u>List of Business Goals/Strategies</u> A list of major business goals, objectives, strategies, or critical success factors significant to the enterprise relative to motivation. The list is at a fairly high level of aggregation. It defines the scope or boundaries of the models (i.e., the rows beneath it).
Owner (enterprise)	<u>Work Flow Model</u> The model of the actual enterprise allocation of responsibilities and specification of work products. Typically, an organization chart expresses the allocation of responsibilities, but other supporting documents describe the work products. To be complete, the organization chart would have to be supplemented with work products (e.g., control work, coordination work, and operational work) and the originating and receiving organization units identified.	<u>Master Schedule</u> A model of the business cycles comprised of an initiating event and an elapsed time. There are two typical notations for expressing points in time and lengths of time, P.E.R.T. charts and the Senge or systems thinking models. Senge models are not definitive in relation to the length of the time cycle or sequence.	<u>Business Plan</u> A model of the enterprise business objectives and strategies that constitute the motivation behind enterprise operations and decisions. Although there has been considerable focus on management theory in academia, no commonly accepted notation for the motivation concepts exists.

Perspectives	People (who)	Time (when)	Motivation (why)
Designer (information systems)	<u>Human Interface Architecture</u> The logical systems expression of work flow, which includes specification of the roles of the responsible parties: management, administration, knowledge-worker, engineering, marketing, etc., and the logical specification of work products (e.g., voice, text, graphics, video, etc.).	<u>Processing Structure</u> The logical systems specification of points in time (i.e., systems events) and lengths of time (i.e., processing cycles). This model describes the system events that trigger transition from one valid state (i.e., point-in-time) to another and the dynamics of that transition cycle. This model is represented in the notation of an entity life history diagram (from the SSADM methodology that originated in the U.K.) or in the notation of an object-oriented Harel state chart. Petri Nets are also used to express time sequence aspects.	<u>Business Rules</u> A logical model of the business rules of the enterprise in terms of intent and constraints. No commonly accepted notation currently exists for business rules.
Builder (technology)	<u>Presentation Architecture</u> This is the physical expression of enterprise work flow including specific individuals and their ergonomic requirements and work product presentation format.	<u>Control Structure</u> The physical expression of system events and physical processing cycles, expressed as control structure, passing "control" from one processing module to another.	<u>Rule Design</u> This is a physical specification of the business rules. The rules are not presently factored out from their implementations and, therefore, are shown as cardinal and optionally in the data models, as procedural code, or as policy specification. However, historically, there have been "inference engine"-style technologies that allow expression of rules quite independent from data and logic, and the tools in which these ideas persist may influence the general marketplace with their formalisms.

Perspectives	People (<i>who</i>)	Time (<i>when</i>)	Motivation (<i>why</i>)
Subcontractor (detailed specifications)	<u>Security Architecture</u> The out-of-context specification of work flow would be identification of the individuals accessing the system and the work or job they were authorized to initiate.	<u>Timing Definition</u> The definition of interrupts and machine cycles.	<u>Rule Specification</u> This will be the out-of-context specification of the business rules.

Appendix C

Glossary of Terms

Applications Architecture	A component of the design architecture that defines the major applications needed to manage data and support business functions.
Applications Models	A component of the design models used to define the Federal Enterprise applications and their interfaces. In the current architecture, the applications models define what applications are in place today to manage data and support business functions. In the target architecture, the applications models define the applications needed to manage data and support business functions.
Architecture Description	An architecture representation or blueprint prepared in accordance with a framework.
Architecture Drivers	The external component of the Federal Enterprise Architecture Framework representing an external stimulus, which causes the enterprise architecture to change. Architecture drivers consist of two sub-components: business and design drivers.
Architecture Segments	<p>Consist of focused architecture efforts, such as a common administrative systems architecture or major program areas, such as trade or grants, and represents a specific enterprise in the overall Federal Enterprise Architecture. Each architecture segment is composed of current and target architectures, limited in scope by the focus of the segment.</p> <p>An architecture segment is a major business area of the overall Federal Enterprise. It can be considered to be an event-driven process, such as grants, that crosses the Federal Enterprise and has commonality of process, data, purpose, and application to warrant consideration of inclusion in the Federal Enterprise Architecture.</p>
Builder's View (Technology Model)	A perspective or point of view from the Zachman Framework. In the Federal Enterprise Architecture Framework, the builder's perspective considers the constraints of tools, technology, and materials. The builder's plans correspond to the technology model, which must adapt the information system model to the details of the programming languages, input/output (I/O) devices, or other technology.
Business Architecture	The business architecture is a component of the current and target architectures and relates to the Federal mission and goals. It contains the content of the business models and focuses on the Federal business areas and processes responding to business drivers. The business architecture defines Federal business processes, Federal information flows, and information needed to perform business functions.

Business Drivers	A component of the architecture drivers that are the change agents (e.g., new business requirements that cannot be met by the current architecture or that can be improved by changing the architecture).
Business Models	A component of the architecture models representing the current and target Federal business architectures. The business models are representations of business data used for defining business needs, processes, and information.
Business Logistics System	The business logistics system is a model of the locations of the enterprise and their connections (i.e., voice, data, post or truck, rail, ship, etc.). It includes identification of the types of facilities at the nodes (i.e., branches, headquarters, warehouses, etc.).
Business Process Model	The business process model is a model of the actual business processes that the enterprise performs independently of any system or implementation considerations and organizational constraints. It can be represented as a structured methods-style model expressing business transformations (processes) and their inputs and outputs.
Cell	In terms of the Zachman Framework, a cell is the intersection of a perspective (i.e., planner, owner, builder, designer, subcontractor) and a focus or product abstraction (i.e., entities = <i>what</i> , activities = <i>how</i> , and locations = <i>where</i>). The Federal Enterprise Architecture Framework cells contain enterprise models or descriptive representations. To obtain any degree of interoperability, the cell contents must be precisely depicted and recursive.
Column	Level IV of the Federal Enterprise Architecture Framework is designed as a matrix. Down the left side are the perspectives, and across the top are the product abstractions of those perspectives. Each focus asks a question. The answers to these questions are described depending upon the perspective when answering.
Conventional Architecture Approach	Requires a substantial initial investment in time and dollars. First, a framework must be developed that shows how to prepare an architecture description. Second, the current baseline must be described. Finally, a target architecture must be described. Only after these efforts are completed, is it possible to begin implementing needed architecture changes through design, development, and acquisition of systems.

Current Architecture	<p>Represents the cumulative "as built" or baseline of the existing Federal Architecture. In terms of the Federal Enterprise Architecture Framework, the current architecture has two parts.</p> <ul style="list-style-type: none"> □ The current business architecture, which defines the current business needs being met by the current technology. □ The current design architecture, which defines the implemented data, applications, and technology used to support the current business needs.
Data Architecture	<p>A component of the design architecture, the data architecture consists of among others, data entities, which have attributes and relationships with other data entities. These entities are related to the business functions.</p>
Data Definition	<p>The data definition is similar to a library or encyclopedia containing the definition of all the data objects specified by the physical data model, including the data definition language required for implementation.</p>
Design Architecture	<p>Focuses on the Federal data, applications, and technology required to support the business needs. The current design architecture defines the implemented design used to support the current business needs. The target design architecture defines what will be used to support future business needs.</p>
Designer's View (Information Systems Model)	<p>A perspective or point of view from the Zachman Framework. In the Federal Enterprise Architecture Framework, the designer's perspective contains the logical data model, applications architecture, and system geographic deployment architecture.</p>
Enterprise Architecture Planning (EAP)	<p>EAP is the process of defining architectures to use information in support of the business and the plan for implementing those architectures.</p>
Federal Enterprise Architecture	<p>A strategic information asset base, which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional processes necessary for implementing new technologies in response to the changing business needs. It is a representation or blueprint.</p> <p>The focus of the Federal Enterprise Architecture is limited to common Federal Architecture issues, which benefit Federal organizations and the public if resolved at the Federal level.</p>

**Federal Enterprise
Architecture Framework**

The Federal Enterprise Architecture Framework is an organizing mechanism for managing development, maintenance, and facilitated decision making of a Federal Enterprise Architecture. The Framework provides a structure for organizing Federal resources and for describing and managing Federal Enterprise Architecture activities.

Framework

A logical structure for classifying and organizing complex information.

Goals and Objectives

Part of the strategic direction describing opportunities to accomplish the vision.

**List of Business
Locations**

A list of locations in which the enterprise operates. The list is a fairly high level of aggregation. The model defines the scope, or boundaries, of the models of locations connected by the enterprise.

List of Business Objects

A list of objects (or things or assets) in which the enterprise is interested. The list is a fairly high level of aggregation. The model defines the scope or boundaries, of the models of objects significant to the enterprise.

**List of Business
Processes**

A list of processes or functions that the enterprise performs or the transformation of enterprise inputs into outputs. The list is a fairly high level of aggregation. The model defines the scope or boundaries of the models of processes the enterprise performs.

Logical Data Model

It is a model of the logical representation of objects about which the enterprise records information, in either automated or non-automated form. It would be represented as a fully attributed, keyed, normalized entity relationship model reflecting the intent of the semantic model.

Models

Models are representations of data. Data may be represented or modeled in various ways.

Network Architecture

It is the specific definition of node addresses and line identification.

**Owner's View
(Enterprise or Business
Model)**

A perspective or point of view from the Zachman Framework. In the Federal Enterprise Architecture Framework, the owner's perspective contains the semantic and business process models, and the business logistics system.

Physical Data Model	It is a technology constrained, or physical representation, of the objects of the enterprise. The representation style of this model would depend on the technology chosen for implementation. If relational technology is chosen, this would be a model of the table structure required to support the logical data model in a relational-style model. In an object-oriented notation, this would be a class-hierarchy/association style model.
Planner's View (Scope)	A perspective or point of view from the Zachman Framework. In the Federal Enterprise Architecture Framework, the planner's perspective contains the list of objects important to the business, process the business performs, and locations in which the business operates.
Product Abstraction	The contents of a particular Zachman Framework column.
Programs "Supporting Software Components (i.e., Operating Systems)"	The programs derived from the action diagram-style or object-style specifications for the implementation. With the appropriate engineering design, these could become the pre-fabricated components to be assembled into more than one implementation.
Principles	A component of the strategic direction. In terms of the Federal Enterprise Architecture, the principles are statements that provide strategic direction to support the Federal vision, guide design decisions, serve as a tie breaker in settling disputes, and provide a basis for dispersed, but integrated, decision making.
Reverse Engineering	Maintaining models over time to avoid reinventing the wheel or recreating the enterprise models.
Rows	Level IV of the Federal Enterprise Architecture Framework is a matrix. Down the left side are the perspectives, and across the top are the product abstractions: what, how, where of those perspectives. Each row represents a total view of the solution from a particular perspective. The rows are planner (objectives/scope), owner (enterprise), designer (information systems), builder (technology), and subcontractor (detailed specifications).
Segment Architecture Approach	Promotes the incremental development of the Federal Enterprise Architecture segments within a structured enterprise architecture framework. In terms of the Federal Enterprise Architecture, this approach allows the Federal Government to focus on major business areas and is more likely to succeed, because the size of the Federal effort is limited.

Semantic Model

A model of the actual enterprise objects (i.e., things, assets) that are significant to the enterprise. Typically, the semantic model would be represented as an entity/relationship model and would be at a level of definition expressing concepts (i.e., terms and facts) used in the significant business objectives/strategies implemented later as business rules.

Standards

A component of the Federal Enterprise Architecture Framework. Standards are a set of criteria (some of which may be mandatory), voluntary guidelines, and best practices. Examples include the following.

- | | |
|--|---|
| <input type="checkbox"/> Application development | <input type="checkbox"/> Asset management |
| <input type="checkbox"/> Project management | <input type="checkbox"/> Technology evaluation |
| <input type="checkbox"/> Vendor management | <input type="checkbox"/> Architecture governance |
| <input type="checkbox"/> Production operation | <input type="checkbox"/> Configuration management |
| <input type="checkbox"/> User support | <input type="checkbox"/> Problem resolution |

Strategic Direction

A component of the Federal Enterprise Architecture Framework. The strategic direction guides development of the target architecture. The strategic direction incorporates the vision (a succinct and strategic statement describing the targeted end state for the architecture in five years), principles for guiding the architecture evolution, and goals and objectives for managing it and determining progress towards achieving the vision. The strategic direction must remain consistent with Federal direction stated in the CIO Council Strategic Plan.

Subcontractor's View (Detailed Specifications)

A perspective or point of view from the Zachman Framework. In the Federal Enterprise Architecture Framework, the subcontractor's view contains the data definition (i.e., library or encyclopedia), programs (i.e., supporting software components, such as operating systems), and network architecture.

System Design

Considered a model; however, technically, this would not be a model but a design because the enterprise is no longer visible in the representation. At a high level of abstraction, it would be a structure chart and in detail, action diagram-style expressions that would constitute implementation of the logical systems, or application architecture. In object-oriented notation, this would be the methods and their realization.

System Geographic Deployment Architecture

A logical model of the implementation of the business logistics system depicting the types of system facilities and controlling software at the nodes and lines (e.g., processors/operating systems, storage devices/DBMS, peripherals/drivers, lines/line operation systems, etc.).

Target Architecture

Represents a desired future state or "to be built" for the enterprise within the context of the strategic direction. The target architecture is two parts.

- ❑ Target Business Architecture - Defines the enterprise future business needs addressed through new or emerging technologies.
- ❑ Target Design Architecture - Defines the future designs used to support future business needs.

Technology Architecture

The model is the physical depiction of the technology environment for the enterprise showing actual hardware and systems software at the nodes and lines and their systems software, including operating systems and middleware.

Technology Drivers

A component of the architecture drivers. Technology drivers represent change agents for the enterprise architecture and include emerging technologies offering new solutions for business needs (e.g., new and enhanced software and hardware and their combinations with a variety of deployment approaches). Incorporation of new technology allows the architecture to support business requirements better, faster, and cost effectively.

Technology Models

Define current and target technology architectures. For the current architecture, technology models define what technology is in place today to provide an environment for systems that manage data and support business functions. For the target architecture, technology models define the technology needed to provide an environment for systems that manage data and support business functions.

Transitional Processes

A component of the Federal Enterprise Architecture Framework. These processes support migration from the current architecture to the target architecture. Examples include: engineering change control and configuration management, capital IT investment planning and decision making, investment management review, segment coordination, market research, asset management, and procurement practices.

In terms of the focus or abstractions, the transitional processes frequently answer the questions: who, how, and when.

Vision

A succinct and strategic statement describing the targeted end state for the architecture in five years. The vision provides strategic direction and is used to guide resource decisions, reduce costs, and improve mission performance.

Appendix D

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Documents

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